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Rev. 07/10/02

USEPA Comments on the November 2000, Field Sampling and Analysis Plan (FSAP)

Specific Comments:

1. *Response 3: Response 3 references Response 2 of the PSVP. It is stated in the Response 2 of the PSVP that chloride is often considered a "tracer" of leachate migration, but not an indicator of natural attenuation. This is a misleading statement, because, during biodegradation of chlorinated hydrocarbons dissolved in groundwater, chloride is released into the groundwater. This will result in elevated chloride concentrations in the groundwater contaminant plume compared to background concentrations. However, if there is an increase in the chloride concentration at the Site, it will be difficult to attribute the increase either to leachate migration or natural attenuation. Because of the above argument, USEPA agrees that the chloride analysis should be included in the groundwater monitoring program and not in the MNA analytical list.*

   Response: Comment noted.

   Response 3, Section 3.2.1: It is stated that "The only volatile organic compounds (VOC) detected in groundwater at the H.O.D. Landfill are vinyl chloride, cis-and trans-dichloroethene, trichloroethene, and carbon disulfide. Therefore, these four VOCs are included in the surface water monitoring program." In the Remedial Investigation (RI) Report, Table 4-9 has also listed acetone, methylene chloride, benzene, and toluene as VOCs detected historically in the groundwater. Why are these VOCs not included in the surface water monitoring program?

   Response: WMII and RMT believe that the acetone, methylene chloride, benzene, and toluene data in Table 4-9 do not represent site-related impacts. Table 4-9 tabulates historical, pre-RI, data. Noninclusion of these compounds is based on six observations as follows:

   - The acetone, methylene chloride, benzene, and toluene detections are occasional; less than 50 percent of the samples analyzed reported at least one of these compounds.
   - All of the detections are low concentrations, with nearly 80 percent being qualified as estimated concentrations because the results were in question.
   - Most (53 percent) of the detections were associated with blank contamination.
   - The reported detections do not show a spatial or temporal distribution that indicates a plume of impact emanating from the landfill.
   - These compounds were included in the pre-RI results, but were not detected during the RI sampling events.

- These contaminants were not selected by the USEPA as contaminants of concern (COCs) in the ROD.

Based on the absence of confirmed detections of acetone, methylene chloride, benzene, and toluene and their exclusion from the list of COCs in the ROD, WMII and RMT believe that these VOCs should not be included in the surface water monitoring program.

WMI and its contractor, RMT, claim that SVOCs have not been included for analysis because they were not detected in the groundwater. However, based on the RI sampling, several PNAs and one phthalate were detected in the sediment samples collected at the Site. Phthalate was also detected in the leachate samples collected during the RI. Most of the PNAs and phthalate detected in the sediment samples were also detected in the surface soil samples collected during the RI. Based on the above information which suggests that the sediments in the creek appear to be impacted by the landfill operations, why are PNAs and phthalates not included in the surface water monitoring program?

Response: The PNAs and phthalates in question were not selected as COCs in the ROD. Furthermore, these compounds are commonly detected in surface soil and sediment across the United States (Simcik, 1996; Bradley, 1994; Chuang, 1995; and Cramer & Lund, 1995). In the data from the site, these PNAs were not detected in surface waters and the sediment detections were at low concentrations, below the laboratory detection limits. Based on these findings, we believe that it is not necessary to include these parameters in the routine monitoring program.

During the March 9, 2001 meeting between USEPA, Weston, Illinois EPA, WMI, and RMT, WMI agreed to include a full scan of VOCs and SVOCs as part of the surface water monitoring program, if surface water monitoring data indicates that the surface water quality has degraded as a result of a potential leachate release. Please revise the FSAP and other documents as appropriate to include this plan.

Response: Subsection 8.3.2 of the PVSP addresses contingent evaluations of surface water data. This subsection has been revised to state that, if surface water monitoring results indicate that surface water quality has been impacted by a leachate release from the HOD facility, a full scan of VOCs and SVOCs will be undertaken in the subsequent surface water sampling event.

2. <u>Section 3.2.3:</u> ***The start of the surface water monitoring has been changed from the first quarter following the final inspection of the RA construction to final approval of the RA construction report. During the March 9, 2001 meeting between USEPA, Weston, Illinois EPA, WMI, and RMT, WMI agreed to begin monitoring of all agreed-to media***

in the quarter following USEPA approval of the O&M documents (O&M Plan, PSVP, QAPP, and FSAP). WMI also agreed in the meeting to submit an interim, written monitoring plan for the leachate and gas collection system for USEPA approval. The interim period is defined as the time between the start-up of the leachate and gas collection system and USEPA approval of the O&M documents. Please make changes to the O&M documents as appropriate and submit the interim monitoring plan by March 23, 2001.

Response: Subsections 3.1.4 and 3.2.3 have been edited to indicate that groundwater and surface water monitoring will commence within the first quarter following the USEPA's approval of the O&M documents. Subsection 5 of the PSVP has also been revised accordingly to incorporate the initiation of monitoring activities agreed to.

A letter regarding the proposed interim startup and monitoring activities for the H.O.D. Landfill gas and leachate collection systems was submitted to the USEPA on March 23, 2001. Based on this letter and a March 27, 2001, e-mail notification from the USEPA, the referenced O&M startup activities began on April 3, 2001. Subsection 5 of the PSVP has been revised to incorporate the initiation of monitoring for the landfill gas and leachate components of the RA as discussed above.

3. *Section 3.4.2, Sampling Locations: During the March 9, 2001 meeting between USEPA, Weston, Illinois EPA, WMI, and RMT, USEPA agreed to the use of leachate extraction wells as leachate elevation monitoring points, if WMI presented a written procedure to determine the time required for each leachate well to stabilize following the shut down of the leachate collection system. The determined stabilization time for each leachate well, if agreed to by USEPA, will be used by WMI in place of the proposed 12-hour shutdown period noted in the O&M documents. Please make changes to the O&M documents as appropriate.*

Response: Based on discussions during the March 9, 2001, meeting and on the comment above, Subsection 3.4.2 will remain as originally written with the 35 leachate extraction well locations used as leachate head monitoring wells. However, Subsection 3.2.1 of the O&M Plan has been modified to include a written procedure to determine the recovery time required for leachate extraction wells to stabilize following the shutdown of the leachate collection system.

4. *Figure 3-1:–Because of the presence of occupied buildings north and west of the Site, USEPA recommends two additional gas probes: one near the northwest corner of the Site and one west of the Site.*

Response: An additional gas monitoring probe is not necessary near the northwestern corner of the landfill. This is due to the presence of Sequoit Creek and a groundwater

table located at or near the existing ground surface of the property limit. The construction of soil gas probes typically requires perforations to terminate within 5 feet of the ground surface. This requirement makes it impractical to place soil gas probes in areas where the groundwater is near the surface.

During the RA, approximately 21,000 cubic yards (CY) of waste and soil were removed (excavation proceeded until clean, native clay till or saturated peat was encountered at the base and northern sidewall of the excavation area) from the northwestern limits of the landfill and replaced with clean, compacted clay borrow soil. The majority of this soil is located beneath the groundwater surface. This area (approximately 670 feet east-west by 80 feet north-south) extends from near Sequoit Creek to within 100 feet of proposed gas monitoring probe GP6. As noted in responses to the USEPA's comments on the Intermediate Design dated May 3, 2000 (Predesign Investigation Results: Landfill Gas and Leachate Components, Response 5), saturated and fine-grained soil layers are not conducive to the horizontal migration of landfill gas.

An additional gas monitoring probe west of the site is also not warranted, for the following reasons:

- As noted in responses to the USEPA's comments on the Intermediate Design dated May 3, 2000 (Predesign Investigation Results: Landfill Gas and Leachate Components, Response 3), and on geologic Cross Sections A-A' and B-B' of the Remedial Investigation (RI), the shallow water surface is at, or very close to, the surface to the west of the site. Sequoit Creek, which runs entirely along the western edge of the site, is hydraulically connected to the shallow groundwater system in this portion of the site. Thus, the saturated zone of the creek and the shallow groundwater system in this area act as a barrier to the potential migration of landfill gas generated from the H.O.D. Landfill, and an additional gas probe is not warranted.
- The limits of waste is in relative proximity to Sequoit Creek and the site's property boundary. Therefore, placement of an additional gas monitoring probe on the H.O.D. side of the property/creek would potentially place a gas monitoring probe very near, if not through, existing waste, thus giving misleading and inaccurate results regarding the migration of landfill gas.

WMII stated its reluctance to place a gas monitoring probe on off-site industrial property to the west of the site during the March 9, 2001, meeting with USEPA. This reluctance is due to the known waste placement in this area west of the site by entities unrelated to WMII and H.O.D. Landfill past operations; specifically, the former Cunningham/Quaker Village Dump. Figure 9 of the RI (Attachment A) shows the limits of waste placement activities in this area. Per the RI, the Cunningham Dump was open for the dumping of any material, and there was generally no supervision of dumping activities. Thus, placing a gas-monitoring probe west of Sequoit Creek is likely

to only detect landfill gas migration from the Cunningham Dump and not the H.O.D. Landfill.

One additional monitoring well should be included between the impacted well and the village well VW-3. (See PSVP comments on VW-3 for support of this statement.)

Response: Please refer to the response to the PVSP Comment 1 on VW-3.

Two additional surface water sampling points should be included. Surface water sample SW1 should be moved on-site where the creek enters the Site. (See PSVP comments under Specific Response 3 for more explanation of surface water monitoring points.)

Response: Please refer to the response to the PVSP comment No. 14.

5. *Section 4.4.2 - pH requirements: An additional volatile organic analyte (VOA) vial can be collected and checked for proper pH. This does not affect the risk of sample contamination. It is highly recommended that the pH be checked for the VOAs and other applicable parameters (metals, cyanide, and water quality parameters). Improper preservation on many of the water quality parameters greatly reduces the holding time. Litmus (pH) paper can be used to check sample pH. Laboratories may provide preservatives. The preservatives are not always in the bottle but in an ampule or small vial that needs to be added to the sample. Without checking the pH, the risk is that the sample may be shipped without preservative added or be improperly preserved. There are no written requirements or regulations on this subject; therefore, this suggestion is made as a best management practice.*

Response: Suggestion noted. RMT's experience shows that inadequate preservation occurs when the sample matrix is highly buffered. These conditions are not expected at the H.O.D. Landfill; therefore, field pH checks will not be performed.

6. *Response 17: Investigation-Derived Wastes (IDW): Enhance the wording in section 4.10 to cover IDW management beyond personal protective equipment management; most notably, purged well water management. The April, 1992 USEPA "Guide to Management of Investigation-Derived Wastes," (OSWER Directive 9345.3-03FS) states, for the management of aqueous liquids: "Parameters to consider, especially in making the protectiveness decision, include the volume of IDW, the contaminants present in the groundwater, the presence of contaminants in the soil at the site, whether the ground or surface water is a drinking water supply, and whether the groundwater plume is contained or moving." The guidance offers three examples for managing IDW aqueous liquids:*

1. *A site manager has large volumes of groundwater IDW and does not know if it is contaminated. Pouring this IDW on the ground would not be protective, because it may contaminate previously uncontaminated soil or may mobilize contaminants that are present in the soil. Therefore, the site manager stores the water in a mobile tank until a determination is made as to whether the water and soil are contaminated or until the final action.*

2. *IDW is generated from the sampling of background, upgradient wells. Because there are no community concerns or evidence of any soil contamination from other sources, the site manager decides to pour this presumably uncontaminated IDW on the ground around the well.*

3. *Purge water from a deep aquifer is known to be contaminated with RCRA hazardous waste. At this site, if this water were poured on the ground, it could contaminate a previously uncontaminated shallow aquifer that is a potential drinking water source and would have to comply with the land disposal restrictions. The site manager decides to containerize the water within the area of contamination and store it until the final remedy*

Response: Subsection 4.10 of the FSAP has been revised to address management of purge water. The revised text states that purge water from wells will be containerized and returned to the site for disposal in the leachate management system if the prior years sample results from the well(s) show exceedences of the acute surface water standards in 35 IAC 302.208. This is reasonable for the following reasons:

- The volume of IDW is limited (approximately 5 to 10 gallons per well),
- Conditions in the wells are documented in the RI, with most of the wells showing no detectable VOCs.
- The surface and shallow groundwater at the site are not used as a drinking water source.

H.O.D. Landfill is a site with limited shallow groundwater impacts. Disposal of the water on the ground surface is not likely to contaminate a previously uncontaminated aquifer. During the annual reporting of groundwater results, results will be reviewed to assess if this approach remains reasonable.

References:

Bradely, L.J.N., B.H. Magee, and S.L. Allen. "Background Levels of Polycyclic Aromatic Hydrocarbons (PAH) and Selected Metals in New England Urban Soils." *Journal of Soil Contamination*. Vol. 3, pp. 349-361 (1994).

Chuang, Jane C., Patrick J. Callahan, Ronald G. Menton, Sydney M. Gordon, Robert G. Lewis, an Nancy K. Wilson. "Monitoring Methods for Polycyclic Aromatic Hydrocarbons and their Distribution in House Dust and Track-in Soil." *Environmental Science & Technology.* Vol. 29, pp. 494-500 (1995).

Cramer, Curt A. and Kevin D. Lund. "An Evaluation of Naturally Occurring Levels of Polynuclear Hydrocarbons in a Small City and the Impact on Clean-up and Risk Assessment – A Case Study." *Geraghty & Miller, Inc.* Novi, Michigan (1995).

Simcik, Matt F., Steven J. Eisenreich, Katherine A. Golden, Shi-Ping Liu, Elisabeth Lipiatou, Deborah L. Swackhamer, and David T. Long. "Atmospheric Loading of Polycyclic Aromatic Hydrocarbons to Lake Michigan as Recorded in the Sediments." *Environmental Science & Technology.* Vol. 30, pp. 3039-3046 (1996).

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Table 3-3
Proposed Long-term Groundwater Monitoring Points

GROUNDWATER SAMPLING AND GROUNDWATER LEVEL MEASUREMENT POINTS	ADDITIONAL MONITORING POINTS FOR GROUNDWATER LEVEL MEASUREMENT
US1D	US6I*
W8D	W3SB*
PZ4U(1)	*W3SA*
PZ3U(1)	*W4S*
W6S(1)	*W5S*
US6D	*US3S*
W3D	US3I*
US2D	*PZ1U*
R1D	*PZ2U*
US4S(1)	**W2D**
US4D	**PZ1**
US3D	*US1S*
US5D	PZ5U
	PZ6U
	G14S

Notes:
(1) Groundwater samples collected at these monitoring points will not be analyzed for the MNA constituents.
Bold = wells screened in the deep sand and gravel aquifer.
Italics = water table wells.
* = intermediately screened wells for use in calculating vertical gradients, if necessary.
G14S water levels will only be used as a point of comparison to US1S. G14S water levels will not be used to generate potentiometric surface plans.

3.1.4 Monitoring Frequency

As specified in the ROD and in accordance with 35 IAC 811.319(a)(1)(A), groundwater sampling and water level measurement will take place on a quarterly basis for 30 years. Groundwater monitoring will commence within the first quarter following final USEPA approval of the ~~RA construction completion report~~O&M documents (O&M Plan, PVSP, FSAP, and QAPP). After the first USEPA Five Year Review, and in accordance with 35 IAC 811.319(a)(1)(A), the USEPA may allow a reduction in the sampling frequency for each monitoring point to a semiannual basis, provided that monitoring effectiveness is not compromised, that sufficient quarterly data have been collected to characterize groundwater, and that leachate from the monitored unit does not constitute a threat to groundwater.

3.1.5 Well Abandonment

A number of groundwater monitoring wells that are not included in the long-term groundwater monitoring plan, and that are unlikely to provide useful information in the future are proposed for abandonment during the construction phase of the RA. The monitoring wells that are proposed for abandonment are shown on Figure 3-1.

The wells that are proposed for abandonment include G14D, ~~R103~~, G102, G11D, and G11S. G14D was installed in 1974 to monitor groundwater quality conditions in the clay diamicton. The monitoring well cannot contribute to the objectives of the long-term monitoring program because it cannot provide information on groundwater quality or groundwater flow conditions in the surficial aquifer or the DSGA. Therefore, it is proposed for abandonment.

~~R103 is located in the immediate vicinity of US6S and W6S. All three wells are installed in the surficial aquifer; however, W6S is the only well that is screened across the water table. W6S is included in the long-term monitoring program. R103 is proposed for abandonment because it would provide redundant groundwater quality information if it were also included in the long-term monitoring program.~~

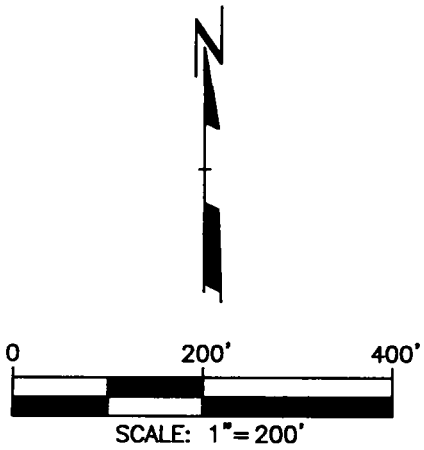
G102 was installed in 1974 to a depth of 25 feet bgs. In 1987, the USEPA installed US4S in the immediate vicinity of G102 and to a similar depth (23 feet bgs). US4S is included in the long-term monitoring program. G102 is proposed for abandonment because it would provide redundant information if it were included in the long-term monitoring program.

G11S and G11D are located in the northeastern corner of the landfill. These wells were installed prior to 1980. G11D was installed to monitor groundwater quality conditions

ABANDONED WILL REMAIN IN PLACE WITH AN AIR TIGHT CAP UNTIL THE GAS COLLECTION SYSTEM IS DEEMED ADEQUATE TO CONTROL AND COLLECT LANDFILL GAS.

2116000N

2115500N



2115000N

NOTE: THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK ON THIS CONTRACT, IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

NO.	BY	DATE	REVISION	APP'D.
3.				
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PROJECT:

WASTE MANAGEMENT OF ILLINOIS, INC.
H.O.D. LANDFILL-FIELD SAMPLING PLAN

SHEET TITLE:

ENVIRONMENTAL MONITORING PLAN

2114500N

DRAWN BY: DEFOEJ	SCALE:	PROJ. NO. 5314.07
CHECKED BY: JAB	1"=200'	FILE NO. ENVIRMON.DWG
APPROVED BY: MJT	DATE PRINTED: APR 18 2001	**FIGURE 3-1**
DATE: APRIL 2001		

WASTE MANAGEMENT

WM

RMT

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608/831-4444

both upstream and downstream of the site will aid in the determination of whether the site negatively impacts surface water quality in Sequoit Creek. Additional samples may be collected in the event that surface water shows signs of impact by the landfill (see Section 8 of the PSVP).

Each surface water monitoring point will be established by installing a staff gauge with the name of the monitoring point. The staff gauges will be used to determine stream stage during each sampling event. Surface water levels will be measured as described in Subsection 4.8.3 of this FSAP. The locations and elevations of the monitoring points and stream stage measurement points will be surveyed as described in Subsection 4.8.1 of this FSAP.

3.2.3 Sampling Frequency

Surface water monitoring will commence within the first quarter following final USEPA approval of the ~~RA construction report~~O&M documents (O&M Plan, PVSP, FSAP, and QAPP). The selected surface water monitoring points will be sampled on a quarterly basis until the first USEPA 5-year review. After the 5-year review, the sampling frequency may be reduced upon the USEPA's approval if it is shown that the applicable standards, as explained in the PSVP, have been met.

3.3 Landfill Gas

3.3.1 Monitoring Network

LFG monitoring will be performed on the LFG collection and control system. In addition, gas probes will be monitored to determine the effectiveness of the system in preventing the migration of LFG.

The LFG management system consists of many features (e.g., gas extraction wells, gas probes, solid-wall gas header piping, condensate traps, blower station, flare station, peripheral equipment). Routine monitoring of some of these components is necessary to evaluate the performance of the system and to make appropriate adjustments to the system to optimize its performance. The monitoring points selected (shown in Table 3-5 and on Figure 3-1) are as follows:

- Perimeter gas monitoring probes
- Gas header at the blower flare building
- Gas extraction wellheads
- Ambient air monitoring locations

the ground surface unless the previous round of sample results shows exceedences of the acute surface water standards in 35 IAC 302.208. If there are exceedences, the water will be containerized and disposed in the leachate management system.

7. When purging is completed, attach a flow-through chamber to the end of the discharge line and continue pumping at the previous rate for approximately 5 minutes before measuring specific conductance, pH, temperature, ORP, dissolved oxygen, and turbidity. Also, characterize the color of the samples at the time of the turbidity measurement.
8. Begin sample collection for the constituents presented in Section 2 of this FSAP as soon as purging is completed. The containers and preservatives specified in Table 4-1 will be used. Reduce flow rate to approximately 0.1 L/min to fill containers. Pump at the reduced rate for 5 minutes before filling containers. Fill the sample containers in the following order (if the analytes are required by the Plan):
   - Volatile organic compounds
   - Metals
   - Other inorganic and organic constituents
9. Place samples on ice in a cooler immediately following collection.
10. Complete sample collection and chain-of-custody documentation.
11. Cap the well, and close and lock the protective casing cover.

The groundwater samples will be placed in an iced cooler and stored in accordance with chain-of-custody requirements specified in the QAPP until shipment to the laboratory (or laboratories) is arranged. Monitoring well purging, equipment calibration, and sample collection will be recorded as described in Subsection 4.3 of this FSAP. An example of the log is provided in Attachment A. Chain-of-custody forms will be completed for all samples as described in the QAPP.

4.4.3 General Quality Assurance Considerations

The sample collection procedures presented in this FSAP are designed to provide samples of the required quality for the long-term monitoring program. All field personnel will be required to understand the requirements of this FSAP and will be trained in the use of the equipment and the techniques specified.

The monitoring task leader (MTL) is responsible for reviewing the day-to-day activities of the monitoring program to ensure that the procedures in the Plan are followed. Specific activities that will be implemented by the MTL include the following:

4.9.2 Sample Containers

Sample containers for chemical analyses will be provided by the analytical laboratories as described in Subsection 4.6.2 of this FSAP and in the QAPP, included as Appendix B to the PSVP.

4.9.3 Decontamination Procedures

Downhole Measurement Instruments

These instruments are limited to water-level indicators. This equipment will be rinsed with potable or deionized water and wiped dry before use on the site. Rinsing and drying will also take place between each monitoring well measured during the course of a site visit. Rinse waters will be discharged to the ground surface.

Groundwater Sampling Pumps

Pumps already dedicated to monitoring wells will be left in-place and will therefore not require decontamination.

In-field Chemistry Instruments

In-field measurement electrodes will be rinsed with deionized water, and the flow-through cell will be rinsed with potable water. This procedure will be followed at the beginning and end of each sampling round and prior to, and following, each monitoring well and leachate well sample collection. Rinse waters will be discharged to the ground surface.

4.10 Management of Investigation-derived Waste

4.10.1 Personal Protective Equipment

All Personal Protective Equipment (PPE) will be removed and decontaminated by evaporation (if necessary, for small amounts of low-contamination organic fluids). PPE will then be either stored on-site or sent off-site for disposal, as specified in OSWER 9345.3-03FS.

4.10.2 Purge Water

Purge water generated during groundwater sampling will be disposed on the ground surface adjacent to the well, except in instances where results exceed 35 IAC 302.208

acute standards. In the instances the purge water will be containerized and disposed in the leachate management system. This comparison to the 35IAC 302.208 standard will be reviewed during preparation of the annual report for the site

Section 6
Leachate Monitoring

6.1 Leachate Level Measurement

The measurement of leachate level will be conducted to establish leachate head levels in the landfill, and subsequently, extraction effectiveness.

Leachate level measurements are made in reference to an established reference point on the well casing. This reference point will be documented in field records, as described in Subsection 4.3. Reference point elevations will surveyed to NGVD, as described in Subsection 4.8.1 of this FSAP.

Leachate level measurements will be made and recorded to the nearest 0.01 foot. The depth to leachate will be measured using a water level indicator. This method consists of a spool of small-diameter insulated steel cable with a probe attached to the end. Depth to leachate is read from permanent marks on the cable or tape to which the probe is attached. Depth is recorded by measuring the distance between the nearest permanent foot mark and the point where the meter indicated the water level. Before use, these devices are prepared according to the manufacturers' instructions (if appropriate) and checked for visual damage or defects.

During leachate recovery periods, leachate levels will be measured in the recovery wells and recorded using pressure transducers and digital dataloggers. Pressure transducers consist of a small-diameter insulated cable and breathing tube (to correct for variation in barometric pressure) with a stainless-steel probe attached to the end. The probe measures pressure head at user-defined time intervals, which are then recorded using the digital datalogger. Measurements are commonly recorded to the nearest 0.001 foot. The pressure head measurements relate to the pressure due to the vertical column of water above the transducer probe. When the pressure head measurements are used in association with depth to water measured from a known elevation, such as the top of the well casing, they can be converted to total hydraulic head measurements. Before use, these devices are prepared according to the manufacturer's instructions (included in Attachment D of this FSAP) and checked for visual damage or defects.

Attachment D
User's Manual for Pressure Transducer/Data Logger System

In-Situ Inc.
Helping monitor the earth's resources

HERMIT 3000

Data Logger

Operator's Manual

October 1997

Mailing Address:	*Shipping Address:*	*Phone:*	307 742 8213
In-Situ, Inc.	In-Situ, Inc.	*Fax:*	307 721 7598
P.O. Box I	210 South Third St.	*Internet:*	http://www.in-situ.com
Laramie, Wyoming 82073-0920	Laramie, Wyoming 82070	*Support Line:*	800 446 7488
USA	USA		*(US & Canada)*

Guidelines & Precautions

- *To protect the interior from moisture when not using the keypad or LCD, keep the HERMIT 3000 lid securely closed and the Purge knob in the "Closed" position.*
- *Do not submerge any part of the instrument or allow it to stand in water. Promptly dry rain or other liquid that lands on the faceplate.*
- *Retain all packing materials for future shipment of the HERMIT 3000.*
- *To avoid damage from Electro-Static Discharge (ESD) when connecting the HERMIT 3000 to a computer, observe good ESD practices.*
- *Do not attempt to open the case or service the instrument, except to replace the alkaline battery.*

Contents

1 Introduction

The Hermit 3000 is a compact electronic processing and storage mechanism in a weatherproof housing. The 8-channel data logger features

- sealed, weatherproof housing made of impact-resistant plastic
- internal operating system
- integral keyboard and 4-line backlit LCD
- RS232 and RS422 serial ports
- connectors for up to 8 standard 4-20 mA sensing devices
- internal barometric pressure sensor
- 2 relays for controlling external equipment triggered by test conditions
- 10 test capacity (without dumping data)
- 3 test types, based on linear, logarithmic, and event sampling schedules
- available with lithium or alkaline battery pack
- wide operating temperature range (-40° to +70 degrees C with lithium battery)

Features

The HERMIT 3000 provides two convenient ways to set up for data collection.

Internal Software

The HERMIT's easy-to-use menu system is operated from the front panel keypad and displayed in a 4-line display window.

Win-Situ

When a Microsoft® Windows®-capable PC is available, the HERMIT 3000 can be programmed via Win-Situ™ (v. 2.1 or later), In-Situ's Data Acquisition Software for Windows. Win-Situ provides a graphical user interface with intuitive point-and-click functionality to simplify programming tasks. It can also display graphs of test data.

Win-Situ has its own operator's manual, the *Win-Situ User's Guide*. It describes everything you need to know about communicating with the HERMIT 3000 from a computer: installing the software, setting up tests, collecting data, transferring data to the computer, displaying, manipulating and graphing data, and more. Win-Situ also provides On-Line Help.

Network Communications

The HERMIT can handle both RS232 and RS422 communication protocols.

- The HERMIT communicates directly with a personal or portable computer through its RS232 port. An RS232 communication/power cable accessory makes the connection to a standard computer serial port.
- RS422 protocols permit longer cable lengths, faster data transmission speeds, and can accommodate as many as 32 HERMIT 3000s or other RS422 devices in a network. RS422 connection requires an RS422 communication/power cable. If computer connection through the HERMIT's RS422 port is desired, the computer must have an RS422 port, or a simple RS422 to RS232 converter.

Wakeup

The HERMIT 3000 uses a technique we call "sleeping" to minimize power consumption and achieve a battery life measured in years instead of months. When the instrument is asleep—whenever there is no immediate task to perform—only its internal clock remains active. The HERMIT 3000 will "wake" when you press the WAKE key, when its internal clock indicates it is time to take a data point, or when you are directly communicating with it via Win-Situ.

The Clock

The HERMIT 3000 has an internal real-time clock, which is used to program and record the start date and time of tests, and to take readings at the specified sample interval. You can set the clock from the keypad, or use Win-Situ to synchronize it to a PC clock.

Data Storage

The HERMIT's data storage memory is non-volatile and requires no power to retain stored information. Even if the battery pack should fail, data will remain safe. With fresh backup batteries the estimated data retention is approximately 10 years. The unit can capture and store hundreds of thousands of

readings before the internal operating batteries need replacement.

The memory capacity is 944 Kilobytes. The number of data points that can be stored will vary depending on the number of probes in use; the barometric pressure is stored each time the HERMIT takes a reading. Win-Situ can display a graphic representation of the approximate remaining capacity.

Power

The HERMIT 3000 is available with an alkaline or lithium battery pack. The alkaline battery can provide 14-18 hours and the lithium battery 48-50 hours of continuous use (no backlight). Actual battery life will depend on the number and types of probes, and the sampling frequency. For example, using one In-Situ pressure probe and external power for setup and downloads, the alkaline battery can power up to 500,000 data points, and the lithium battery up to 1,500,000 data points.

The HERMIT's internal software can tell you the battery type and last replacement date; Win-Situ can display a graphic representation of the approximate remaining capacity.

Battery life can be extended by connecting to external power whenever possible, using the communication/power cable accessory. The unit may be connected to a solar-cell auxiliary power system or many other local low-voltage power supplies.

Probes/Channels

The HERMIT 3000 has eight external channels for standard 4-20 mA probes or other sensing devices, plus an internal barometric pressure channel. The channels can be used singly or in any combination.

Tests

The HERMIT 3000 allows you to completely describe the conditions under which readings are to be taken and stored. Up to 10 tests, of three different types, may be described. A test may use any or all of the connected monitoring devices as sources of data.

Using Win-Situ, test data are easily and rapidly transferred to the computer in binary format; then Win-Situ converts the file to text format so it can be read and printed. Win-Situ's companion application Data Manager can display, manipulate, print, and graph test data.

Tests remain in the HERMIT 3000 until you delete them. To prevent accidental erasure, deleting is a deliberate, two-step process.

Relays

Two programmable relay/alarm contacts may be set to activate pumps, external alarms, etc. on a high or low reading from any test channel.

Introducing the HERMIT 3000

Hint: New latches can be stiff. If a latch is hard to open, apply pressure to the top front corner of the case with one hand while pulling the latch up with the other.

Opening

To open the HERMIT 3000, turn the purge knob (at the front, under the handle) counter-clockwise. Flip both latches up and raise the lid.

Turning "On"

The HERMIT's on/off key is labeled WAKE. Press it to turn the instrument on. This "wakes" the instrument from its "sleep" mode, which conserves power. The HERMIT retrieves internal system information, and then presents its START display.

The HERMIT 3000 will remain awake as long as you are using the keyboard. If you haven't pressed a key for a few minutes, the

Menu overview, for reference

4-line x 40 character liquid crystal display (LCD)

Probe connectors 1-4

Internal atmospheric pressure sensor openings on back and in one foot

Serial ports and relay connector are on the back

Probe connectors 5-8

Purge knob

e the backlight feature only as necessary. Excessive use of backlight will ..iously impact battery life.

instrument will go back to sleep and the display will go blank. You can change the length of this "sleep delay" if you like. We'll see how to do that in Section 2.

Backlighting the Display

The HERMIT 3000's large, easy-to-read LCD (liquid crystal display) has excellent readability even in direct sunlight; in fact, the more light the better.

When viewing the display in low ambient lighting, it may be convenient to use the electroluminescent backlight. Press the BACK LITE key to turn the backlight on; press it again to turn the backlight off.

The backlight will switch off automatically when the HERMIT 3000 goes to sleep.

Turning "Off"

At the START display, press the WAKE key. The HERMIT 3000 will blank its display and go to sleep. This action helps to extend battery life by cutting short the normal sleep delay. This function is only available from the START display.

hen shipping the ERMIT 3000, leave the purge knob Open.

Closing

To protect the interior from moisture when the keypad is not in use, close the lid securely and turn the purge knob clockwise to the closed position.

How To Use This Manual

If you have just received your new HERMIT 3000, read the Appendix before you attempt to operate the instrument. It contains unpacking instructions and other important owner's information.

The rest of this manual describes and explains the HERMIT 3000's internal operating software. When a PC is available, you will generally find that you can set up probes and tests very quickly using Win-Situ. However, there will be times when you don't have a PC handy. THE ONLY FUNCTION YOU CANNOT PERFORM FROM THE HERMIT ITSELF IS DOWNLOADING ("extracting") DATA. Everything else can be done right from the front panel.

Section 2 is a Quick Tour of the HERMIT 3000's menu structure and functions. Here you'll find a quick overview of essential tasks, and directions on where to go for detailed instructions. The Quick Tour includes a couple of keyboard examples.

Sections 3-5 discuss the programming and control features of the HERMIT 3000, in the order you will most likely use them.

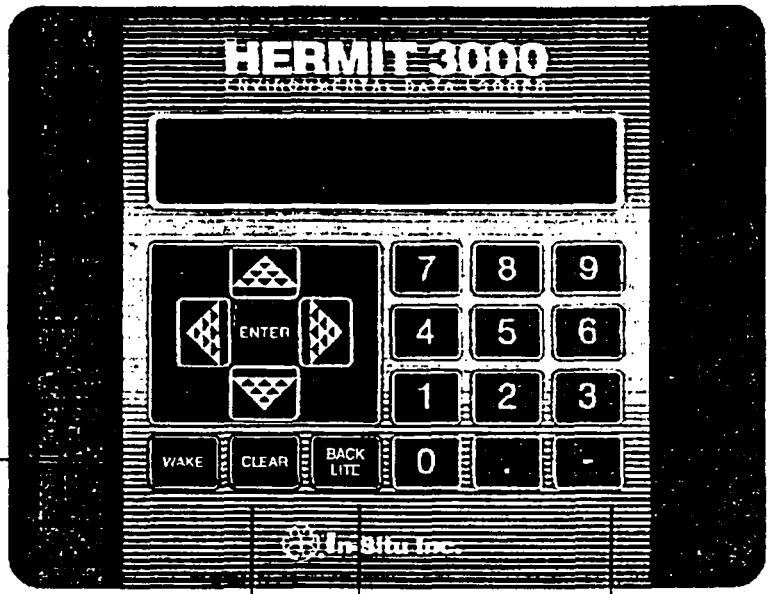
Section 3 covers the **Probes** or other 4-20 milliAmp devices connected to the HERMIT 3000's eight numbered probe connectors.

Section 4 explains how to define, start, and stop **Tests**.

Section 5 is about viewing test **Data** in the HERMIT, and deleting tests from the HERMIT.

Section 6 is a brief overview of **Win-Situ**, especially the Extract Data function that copies tests from the HERMIT 3000 to a PC.

Section 7 covers the Utility and Help menus. Section 8 provides warranty and service information.



WAKE is the HERMIT's "on/off" key

CLEAR is the "Escape" key; abandons edits, backs out of menus

BACK LITE makes the LCD easier to read in dim light

Numeric keypad

2 Getting Started

Reminder:

When a PC is available, you can use Win-Situ to set up probes and define tests.

This section is a Quick Tour of the HERMIT 3000's operations using the keypad and the internal operating software.

How to Wake the HERMIT

To conserve battery life, the HERMIT 3000 powers off ("goes to sleep") whenever there is no immediate task to perform. When the instrument is asleep, only its internal clock and keyboard circuits remain active (the data storage memory is non-volatile and requires no power to retain stored information). The HERMIT 3000 will wake up when its internal clock indicates the time for a data point or when you press the WAKE key.

Try it now. Press the **WAKE** key firmly and then release it. The HERMIT 3000 takes a few seconds to connect the CPU (central processing unit) and retrieve internal system information. Then the START menu is displayed (see Figure 2-1).

The START display:

- is the point of entry into the HERMIT 3000's operating system.
- is shown when you wake the unit up.
- lists the HERMIT's four Main Menus.

The Menus

The HERMIT's functions are presented in the form of Main Menus and Action Menus. The Main Menus are designed to steer you quickly to the area where you want to be. The Action Menus initiate specific actions in two principal operation areas: Probes and Tests. Here's a quick summary:

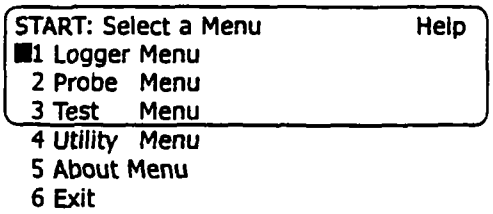


Figure 2-1. The START display. The outline represents the HERMIT's screen. The rest of the menu is accessible by pressing the Down arrow, or keying in a number.

The **Logger Menu** lets you look at information about the HERMIT 3000, give it a name, and set its clock. In Win-Situ, these functions are located on the Device Menu.

The **Probe Menu** is used to set up and read the 4-20 mA devices connected to the HERMIT's eight numbered probe connectors. Its counterpart in Win-Situ is called the Probe Facility.

The **Test Menu** controls the data collection process, from initial test setup to viewing test data. In Win-Situ these test operations are carried out in the Test Facility.

The **Utility Menu** has some useful housekeeping options like setting the sleep delay and reloading firmware. These functions are not available in Win-Situ.

The **About Menu** has support phone numbers, copyright and other information.

In addition, Help is available from the Help menu. To display it, press the up arrow until the cursor is on the H in the word "Help" at the upper right corner of the screen, then press ENTER.

Navigation Principles

The blinking **cursor** is your place marker.

UP ARROW and **DOWN ARROW** move the cursor through menus and lists.

ENTER selects, opens, closes, or executes the item the cursor is on.

- Press ENTER to select a menu or a numbered option in a menu.
- Press ENTER to open a field for editing.
- Press ENTER to close a field after editing.

LEFT ARROW and **RIGHT ARROW** display available choices in fields.

CLEAR abandons a field or menu without saving changes; can be pressed repeatedly to back out to the START display.

Shortcut to select a menu option:

Simply enter its number on the keypad. The cursor will jump to that line.

Let's try out some of these principles by giving the HERMIT a longer sleep delay.

Example: Changing the Timeout

1. If the display is blank, press WAKE. After a moment, the HERMIT presents the START display (Figure 2-1).

   The START display is 6 items long, but since the HERMIT's window displays just 4 lines at a time, we can't see the Utility Menu, which is the option we want.

2. Press the Down Arrow key until the cursor is on the line that says **4 Utility Menu**, then press ENTER.

   The Utility Menu is displayed. The cursor is "on" the first option, Timeout.

```
Utility Menu: Enter/Select Values   Help
■1 Timeout (minutes) : 2
  2 Reload Firmware    :
  3 Reset CPU Runtime:
```

3. Press ENTER to select Timeout.

A long timeout is useful while you're working, but it also drains the HERMIT's battery.

```
Utility Menu: Enter/Select Values   Help
  1 Timeout (minutes) : ■
  2 Reload Firmware    :
  3 Reset CPU Runtime:
```

   The cursor moves into the Timeout field, on top of the current setting (it's probably 2). Let's increase it to 5 minutes.

4. Press the 5 key on the numeric keypad.

5. Press ENTER. The cursor returns to the beginning of the Timeout line.

```
Utility Menu: Enter/Select Values   Help
■1 Timeout (minutes) : 5
  2 Reload Firmware    :
  3 Reset CPU Runtime:
```

6. Press the down arrow until the cursor is on the line that says **Done.**

7. Press ENTER. This has the following effect:

   - exits the Utility Menu,
   - stores the new Timeout value,
   - returns to the START screen.

You now have 5 minutes without keyboard activity before the HERMIT times out and falls asleep. After this happens once, the Timeout will reset itself back to 2 minutes.

Data Collection: Overview

Now that you're familiar with cursor movement, selecting from menus, entering numerical values, and storing them, let's look a hypothetical data collection session.

The process of collecting a set of data with the HERMIT 3000 is referred to as "running a test." The following steps suggest a sequence you might use to set up the HERMIT 3000, run a test, and transfer the test data to your computer. You can use Win-Situ or the HERMIT's keypad and internal software.

Using Win-Situ

Cross-references are to pages and sections in the *Win-Situ User's Guide* where complete information is provided.

1. Use the communication/power cable to connect the HERMIT's RS232 port to your computer's serial port. Install a probe if you want real numbers, or you can do a dry run first to familiarize yourself with Win-Situ.
2. Install and start Win-Situ (pages 3 & 5).
3. Set up the COM port, if necessary, and establish communication with the HERMIT (pages 5-6).
4. Check that the HERMIT's clock is correct; if not, synchronize it to the computer's clock (page 13).
5. Define the probes that will be taking measurements (Section 4).
6. Take a manual reading to confirm setup (page 21).
7. Collect some data: First, define a test (page 26).
8. Start the test (page 29). Take a look at the data while the test runs (page 30).
9. Stop the test (page 29).
10. Extract the test from the HERMIT to the computer. Save the data file. View it before deleting, if you like (page 30).
11. Delete the test from the HERMIT (page 31).
12. Use Data Manager to display, manipulate, graph, and print the test data (Section 6).

Using the Internal Software

Cross-references are to pages and sections in this manual where complete information is provided.

1. WAKE the HERMIT (page 7).
2. Use the Logger Menu to check the clock, and set it if necessary (page 11).
3. Define the probes that will be taking measurements (Section 3).
4. Take a manual reading to confirm probe setup (page 19).
5. Collect some data: First, define a test (page 24).
6. Start the test (page 27). Take a look at the data while the test runs (page 31).
7. Stop the test (page 27).
8. In Win-Situ, extract the test from the HERMIT to the computer (page 30 of the *Win-Situ User's Guide*). Save the data

Remember that extracting data can only be done from a computer running Win-Situ.

file. ***This step can only be done from Win-Situ.***

9. Delete the test from the HERMIT (page 33).

10. Use Data Manager to manipulate, graph, and print the test data. Refer to Section 6 of the *Win-Situ User's Guide*.

Data Security

When a test is completed, the raw data recorded in memory cannot be altered; however, you may edit the probe setup parameters. Since raw data is stored separately from the probe parameters, you may correct errors in the parameters without having to recalculate your data. This can be done through the HERMIT's menus, or, more conveniently, in Data Manager, Win-Situ's companion program for displaying, manipulating, and graphing test data.

Setting the Clock

The HERMIT 3000's internal real-time clock is used to start and stop tests, and to schedule the probe measurements during tests. You can use Win-Situ to synchronize the HERMIT's clock to the PC clock. Or follow this procedure to set the clock from the keypad.

To set the clock from the keypad:

1. At the START display, select **Logger Menu**.

2. At the Logger Menu, select option **3 Set Date/Time**.

   The cursor moves into the date/time field.

3. Use the numerical keypad to enter the correct date (month/day/year) and time (hours:minutes:seconds). Seconds are optional; hours are on a 24-hour basis.

4. Press ENTER when you're through.

5. Select option **4 Done** to return to the START display.

Viewing Device Information

Device Information on the Logger Menu displays the HERMIT 3000's manufacture and calibration date, hardware and software versions, battery type and last replacement date, and other useful facts.

1. At the START display, select **Logger Menu**.

2. At the Logger Menu, select option **1 View Device Information**.

   The Device Information screen is displayed. "CPU Runtime" is the number of seconds the HERMIT 3000 has been

"awake" since the battery was last replaced. The number may be useful to Customer Service technicians.

Select DONE or press CLEAR to exit the Device Information display.

Setting a Device Name

The HERMIT 3000 comes with a name already programmed, but a unique name can be useful, expecially if you have more than one HERMIT 3000. The name will be displayed in the main window when you're using Win-Situ, and in the header of test data files.

1. At START, select Logger Menu.
2. At the Logger Menu, select option **2 Set Device Name.**
3. To "get into" the Device Name field, press ENTER again. The cursor goes to the end of the editable area.
   - The left arrow erases characters.
   - The down arrow moves the cursor into the 2-line character set.
   - Left & right arrow keys move through the character set.
   - Press ENTER to put the highlighted character into the name field.
   - Arrow back up to the name field when the name is as you want it.
   - Press ENTER to store the name.

For more help on editing alphanumeric fields, see the box on page 21.

3 Probes

The HERMIT 3000 has connectors for 8 external pressure transducers, water quality probes, or other 4-20 mA sensing devices. The general term for all these things in the HERMIT's internal software is "probe."

There are two parts to probe setup:

- **External setup** includes attaching the probe to the connector on the HERMIT case and installing it in the field. For details on the operation of the probe connectors, refer to the Appendix in this publication. Guidelines for setting up water level or water quality probes in a well or other field site may be found in the probe operator's manual.
- **Internal setup** gives the HERMIT instructions for interpreting the probe output. This kind of setup is sometimes called "programming." It can be done in Win-Situ or through the HERMIT's Probe Menus. The Probe Menus are covered in this section.

Internal and external setup may be done in any convenient order, but keep these points in mind:

- the HERMIT can't display probe readings without a probe attached.
- when you connect a probe that's already been programmed, remember to use the same connector number.
- you won't be able to change the setup of a probe that's used in an active (running) test or a scheduled test.

The Main Probe Menu

To display the main Probe Menu (Figure 3-1), select Probe Menu at the START display.

Always set up probes before defining tests.

Remember that the probe numbers correspond to the connector numbers on the HERMIT 3000's case.

If a test is running, you won't be able to Set the probe parameters.

```
Probe Menu: Select a Probe        Help
#  Name:       Type:
■1 Probe #1    Temperature
#2 Probe #2    <---------->
```

Figure 3-1. The top of the main Probe Menu. The down arrow scrolls through the probe list. Press ENTER to select a probe and display the probe actions.

The main Probe Menu displays all 8 potential probes, even if you're only using one or two of them. Probes #1 and #2 are visible when the menu is first displayed (Figure 3-1). Press the down arrow repeatedly to scroll down through the probe list. Or, key in a number to go directly to that probe.

The menu shows the probe (connector) number, the probe name (you can customize the default name supplied), and the probe type. A line of dashes means the probe has not been set up.

To use the Probe Menu:

- first select a probe,
- then select an action.

Probe Actions

Once a probe is selected, the Probe Action menu presents the actions you can choose:

- Set or View the Probe Parameters
- Read the probe
- Clear the probe definition
- Calibrate the probe (pH or conductivity)

The first step in collecting data with the HERMIT 3000 is to set up the probe(s) you will be using.

Setting Up a Probe

1. At START, select Probe Menu.
2. At the main Probe Menu, select a probe number.
3. At the Probe Action Menu, select action 2 **Set/View Probe Parameters.**

   The Probe Definition Menu is displayed, as shown in Figure 3-2. These fields constitute a complete probe definition and are described in order below.

4. **Probe Type**: Press ENTER to select the probe type field. Then press the left or right arrow key to view the types. Press ENTER when the desired type is displayed.
   - Temperature
   - Pressure
   - pH
   - Conductivity
   - Barometric
   - User-Defined: use this if your probe type isn't listed
   - <----------> (undefined), select this to "undefine" a channel that once had a probe attached but doesn't now. *Use this with caution if tests are set up that include this probe number.*

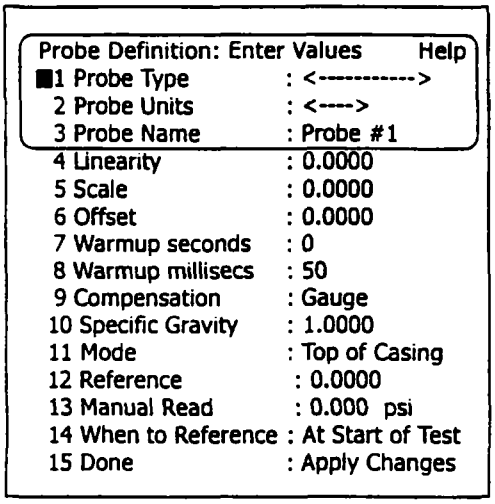


Figure 3-2. The complete Probe Definition menu. Items 9-14 appear only for Pressure types.

The probe type determines the measurement technique used to sample the probe, and the equations used to convert the measurement results to appropriate units.

Remember that the CLEAR key can be used to back out of any display. If you end up in a menu or display that you hadn't intended to be in, just press CLEAR to back up.

5. **Probe Units:** Each type has a default unit. You can accept the unit displayed, or choose a different unit, as follows:

   a. Press ENTER to select the units option,

   b. Display the available units with the left and right arrows,

   c. Press ENTER to select the desired unit.

6. **Probe Name:** A default name is shown, but you can set a custom name up to 16 characters long, if you like. This name will appear in the Probe Menu and on the Test Definition menu when choosing the probes for a test. It also appears in the header of test data files.

   Setting a name takes a bit of time. For details on editing alphanumeric fields, see the box on page 21.

7. **Linearity:** Use the keypad to enter the linearity listed on the probe's data tag or in documentation received with the probe. If linearity is not given, enter zero.

   For a conductivity or pH channel, enter zero. The calibration process (described on page 18) will calculate the linearity.

8. **Scale:** Key in the scale factor from the probe's data tag or documentation received with the probe. If no scale factor is given, enter the probe range.

   For a conductivity or pH channel, enter 16. The calibration process will calculate the scale factor.

9. **Offset:** Key in the offset on the probe's data tag or in documentation received with the probe. If no offset, enter zero.

   For a conductivity or pH channel, enter 4. The calibration process will calculate the actual offset.

   The Linearity, Scale, and Offset parameters program the coefficients of a quadratic equation that will convert the probe

The warmup time is rarely specified on third-party transducers and must often be determined by experiment. In-Situ's standard transducers use a warmup of 50 milliseconds unless specified otherwise. The Warmup Seconds option is provided for devices that require a longer stabilization time. ***Long warmup times will reduce battery life.***

output to the desired units. The values for these "Quadratic Coefficients" can be found in documentation supplied with the probe.

10. **Warmup:** This is the time required for the HERMIT 3000 to power the channel and take an accurate reading. You can enter seconds (up to 30), milliseconds (up to 999), or a combination thereof. For example, to enter a two-and-a-half-second warmup, enter 2 seconds and 500 milliseconds.

    In-Situ pressure probes use a warmup of 50 milliseconds. Water quality probes usually require a longer warmup; refer to the probe operator's manual.

    Total maximum warmup for any one probe is 30 seconds.

If you selected a Pressure type, continue with the steps below. If you are defining any other type of probe, skip to step 17.

Pressure Probe Definition

The following 6 parameters appear for Pressure type probes.

11. **Compensation**: Choose Gauge or Absolute barometric pressure compensation of the probe output.

    Gauge The atmospheric pressure component is removed from the pressure forces detected by the sensor. Units are PSIG (pounds per square inch gauge). Equivalent to vented cable. Normally, if your pressure transducer is on vented cable, you will want to select "gauge" (the default).

    Absolute All pressure forces are measured, including atmospheric pressure. Units are PSIA (pounds per square inch absolute). Equivalent to non-vented cable.

    Note: The HERMIT 3000 measures barometric (atmospheric) pressure continuously during tests. Results are reported on the "last" channel. Since barometric pressure is always available, the HERMIT can easily add it to or remove it from pressure probe measurements regardless of whether the cable is vented or non-vented.

12. **Specific Gravity**: The conversion from pressure to water level requires a specific gravity value. Pure water at 4°C has a specific gravity of 1.0. This is accurate for many groundwater applications. But if the temperature is much over 4°C, or if the working fluid is not water—for example, when monitoring in gasified wells, saline waters, and other contaminants—you will obtain more accurate test results if you use the actual specific

gravity. The Appendix to the *Win-Situ User's Guide* has more information.

13. **Mode:** Choose Top of Casing, Surface, or Pressure Head.

    Top of Casing mode, designed to measure drawdown, is "positive down." Decreasing levels result in *increasing* readings in the data file, because the water level is getting further from the top of the well casing. Increasing levels correspond to *decreasing* readings.

    Surface mode is "positive up." Increasing levels correspond to increasing readings in the data file; decreasing levels result in decreasing readings.

    Head is a straightforward measurement of the pressure exerted by the column of water above the sensor. A Reference is not applicable.

14. **Reference:** For Surface or Top of Casing mode, enter a Reference value—an optional starting point for all the test measurements. The default reference of zero is equivalent to "zeroing" the probe. A Reference is not applicable for Pressure Head measurements.

15. **Manual Read:** If the probe is attached, and submerged in water, this option will display the current head of water above the sensor. This can aid in probe installation and also in selecting a Reference value.

16. **When to Reference:** For Surface or TOC mode, choose Now or At Start of Test (not applicable for Pressure Head measurements).

    The HERMIT takes a "snapshot" of the sensor's raw pressure reading, then substitutes your Reference value. The data file header will show the raw pressure reading and when it was taken.

    If you choose **Now**, the probe is measured when it's defined (after you complete step 17 below) and the raw pressure value is stored until the test starts. All test measurements are relative to the water level at the time you defined the probe.

    If you choose **Start of Test**, the Reference measurement is taken at time t=0. All test measurements are relative to the water level at the moment the test starts.

To store your entries in the Probe Definition Menu, be sure to select the Done option.

To abandon the changes, press CLEAR.

Completing the Probe Setup

To store the definition in the HERMIT's memory:

17. Select the last option on the Probe Definition menu, **Done: Apply Changes**. The HERMIT displays the message "Defining Channel" then returns to the Probe Action Menu.

If a test is running, you won't be able to perform calibration.

Calibrating Water Quality Probes

In-Situ's pH and conductivity probes require field calibration before use. You will need

- PHX-300 or CTS-300 probe
- calibration cup accessory
- pH or Conductivity CalKit, containing calibration solutions and accessories

First, decide which type of calibration you need. This, in turn, determines the number of calibration solutions required.

You don't want the HERMIT to doze off during the calibration procedure, which could take a while, with up to 3 15-minute waiting periods. We suggest you use the Utility Menu to increase the timeout. See page 38. Maximum = 999 minutes.

We recommend the use of external power to conserve the batteries.

- **Linear** uses a two-point linear equation to calculate the line the probe data will follow. Two readings from two different calibration solutions are required.
- **Quadratic** uses a quadratic equation, requiring three readings, and thus three calibration solutions. This method is more accurate but takes a little longer.
- **Single Point** provides a quick re-calibration for a probe that has previously been calibrated with another method.

Get the first calibration solution ready.

Clean and assemble the probe as described in the probe Operator's Manual.

Attach both channels (temperature and pH or temperature and conductivity) to the HERMIT 3000.

Set up the probe parameters as described on page 14. Enter actual values for the temperature channel. For the pH or conductivity channel set Linearity to 0, Scale to 16, Offset to 4, and warmup to as specified in the probe Operator's Manual. Other settings are optional.

Now you're ready to calibrate.

1. Fill the calibration cup with the first calibration solution. Immerse the probe and let it stabilize for at least 15 minutes—the longer the better.
2. After about 15 minutes, read the temperature channel (see the procedure on the opposite page), and make a note of the reading.
3. At the main Probe Menu, select the pH or Conductivity probe.
4. At the Probe Action Menu, select action 5 **Calibrate Probe**.
5. At the next screen, choose Linear, Quadratic, or Single Point calibration.

   The Calibrate Probe Menu appears.
6. For Solution #1, enter the value of the calibration solution. This is written on the bottle (e.g., 4 pH or 450 µS).
7. For Temperature #1, enter the temperature reading you recorded earlier.

If the HERMIT dozes off during the calibration procedure, you'll have to repeat from the top.

Press CLEAR any time you get a busy message, if you don't want to wait.

8. For Measure #1, press ENTER. The HERMIT reads the probe and enters the value.
9. Remove the probe from the calibration solution, rinse thoroughly, and allow it to stabilize in the next solution.
10. When the probe has stabilized, select the line in the Calibrate Probe Menu that says Solution #2.
11. Repeat steps 6-8 for Solution #2, Temperature #2, and Measure #2.

    If you're doing a Quadratic calibration, repeat from step 9 for Solution #3.
12. Select **Done: Apply changes.** The HERMIT calculates new Scale and Offset coefficients and redefines the channel.

Reading a Single Probe

The Monitor All Probes function isn't available while a test is running. However, the single read function can be used during a test.

It's always a good idea to take a few readings to confirm that the probe is properly connected (externally) and set up (internally).

Procedure:

1. At the main Probe Menu, select the probe you want to read.
2. At the Probe Action Menu, select action 3 **Read Probe.**
3. The HERMIT 3000 will power the channel for the programmed warmup time, then read and turn off the channel.
   - **NC** (not connected) means the HERMIT does not detect the probe (no probe connected or faulty connection).
   - **BUSY** means the unit is taking test data at the moment you requested a reading. The HERMIT will keep trying until the operation is successful or you press CLEAR.

   You can press ENTER to take additional readings from the same probe.
3. To return to the main Probe Menu, press CLEAR.

Monitoring All Probes

This option on the Probe Menu displays readings from all defined probes, continually updated. This function can be hard on the HERMIT's battery, and can't be used while a test is running.

Procedure:

1. At the main Probe Menu, select option 9 **Monitor All Probes.**
   - Each connected probe will be read in turn.
   - Readings will be continually updated.

- NC (not connected) means the HERMIT does not detect the probe (no probe connected or faulty connection).
- The usual timeout is not in effect while all probes are being monitored.

2. To exit this function, press CLEAR.

Clearing a Probe Definition

Before clearing a probe definition, the cautious user will first download to a PC any tests that used the probe.

When you disconnect a probe from the HERMIT 3000 and don't attach another in its place, battery power and memory may be wasted when the HERMIT tries to read that channel, either during a test or in the Monitor All Probes function. You can conserve power and memory by clearing the probe definition.

You won't be allowed to clear a probe definition while a test is running.

Procedure:

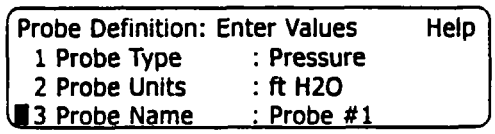
1. At START, select the Probe Menu.
2. At the first Probe Menu, select a previously defined probe that has been physically removed from the HERMIT 3000.
3. At the Probe Action Menu, select action 4 **Clear Probe Definition.**

   The HERMIT 3000 redefines the channel. The Probe Menu displays blanks where previously there was information.

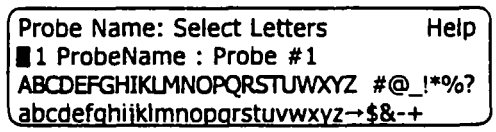
Editing Alphanumeric Fields

To edit an alphanumeric field like Device Name, Probe Name, and Test Name:

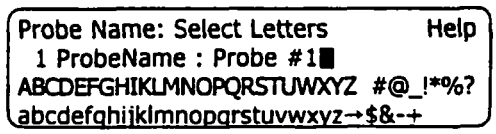
With the cursor on an option, press ENTER to select it from the menu.



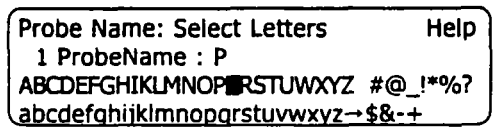
The entire alphabet (upper & lower-case) and symbols, including the space character, appear on the lower two lines. (In the screens shown here, some of the symbols have been omitted.)



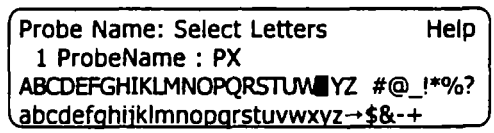
Press ENTER again to open the field for editing. The cursor goes to the end. If there are characters in the field, you can use the left arrow to backspace over them, erasing them as you go.



The down arrow puts the cursor in the top line of the alphabet. The left & right arrows move through the alphabet and other characters.



ENTER puts the current character into the field; the cursor remains in the alphabet.



To insert a space, select the blank between the alphabet and the symbols. To access the lower line, press the down arrow. To enter numbers, use the keypad.

To finish:

- Press the up arrow once or twice to return the cursor to the name field, then
- Press ENTER to return to the menu with the changes accepted.
- Alternatively, press CLEAR to abandon the changes.

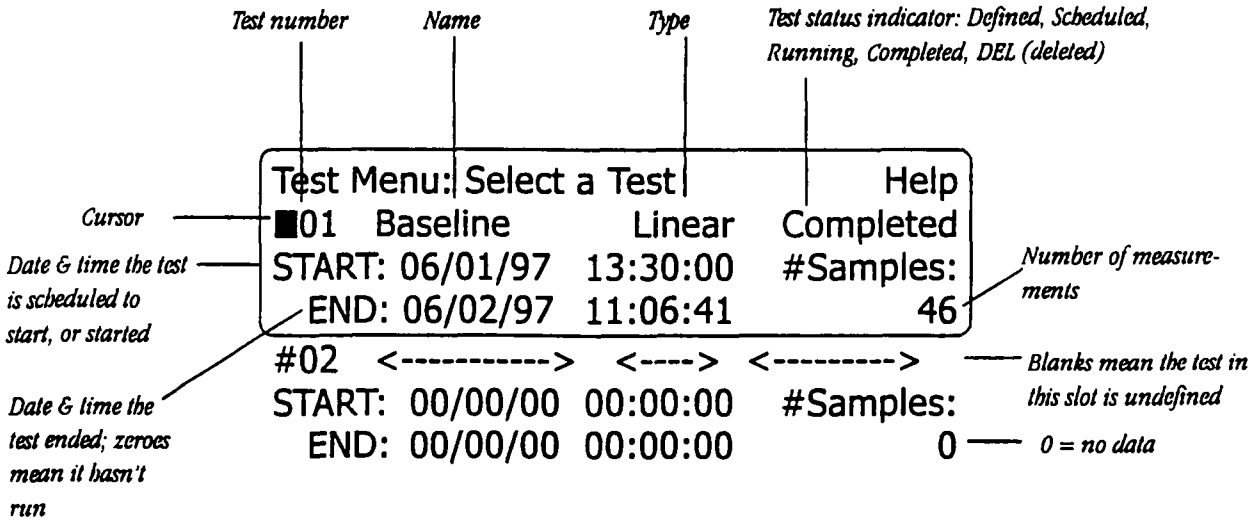


Figure 4-1. The main Test Menu. All 10 test "slots" are displayed here, 3 lines per test. The outline indicates the area of the LCD. Press the down arrow to scroll down through the tests—or key in a test number. Press ENTER to select a test and display the test actions.

4 Tests

Many of the HERMIT 3000's data logging operations can be visualized as actions performed on tests. For example,

- to give the HERMIT instructions for collecting data, you **define a test**
- to end data collection you **stop a test**
- to remove data from the HERMIT's memory you **delete a test**

All of these are carried out in the HERMIT's Test Facility (when communicating via Win-Situ) or its internal Test Menus.

The cursor at the left side of the line is your "marker." To select an item, press ENTER when the cursor is on it.

The HERMIT 3000 allows you to record as many as 10 different tests in memory, each with its own unique setup and data, without having to dump the data between tests. The test numbers are really "slot" numbers, and can be used in any order.

To display the main Test Menu, select Test Menu at the START display.

The Main Test Menu

The main Test Menu displays all 10 potential tests. Each test occupies 3 lines in the display. Since the screen shows 4 lines at a time, the Test Menu can seem confusing at first.

Each test's allotted 3 lines show quite a lot of information (see Figure 4-1 on the opposite page). Each press of the down arrow displays the same information for the next test.

The main Test Menu works like the main Probe Menu: First, select a test, then select an action to perform on the test.

Test Actions

Once a test is selected, the Test Action menu presents the actions you can choose:

- Define the test
- Start the test

Always set up probes before defining tests.

- Stop the test
- Cancel the test
- View the test data
- Delete the test from the HERMIT
- Pack the HERMIT's memory
- Clear the test definition

Section 3 covered the first step in data collection: defining the probe(s). The second step is to define a test.

Defining a Test

If a test is running, you won't be able to define another one.

1. At START, select Test Menu.
2. At the main Test Menu, select an undefined test. It will have a lot of zeroes and blanks in it (e.g., Test #02 in Figure 4-1).

   The Test Action Menu is displayed.
3. Select action 2 **Define Test.**

   The Test Definition Menu is displayed (Figure 4-2). The displayed fields constitute a complete test definition and are described below.
4. **Test Type:** Select from Linear, Log, and Event as follows:

   a. Press ENTER to edit the Test Type,

   b. Press the left or right arrow to display the available types,

   c. Press ENTER when the desired type is shown.

   The box below briefly describes each test type. A fuller description is given in Section 5 of the *Win-Situ User's Guide.*
5. **Test Name:** A custom name of up to 16 characters can be set. The test name is optional but can be useful when you have many tests. For help in setting a test name, see the box on page 21.
6. **Probe List:** Select the probes for this test as follows:

The Define Test option can be used to take a look at any test definition, and to change the definition of a test that hasn't run yet.

Test Types

Linear: Probes are sampled and measurements stored at regular periods in the range of 10 seconds through 7 days.

Log: Probes are sampled and measurements stored in a logarithmic period until a user-specified interval is reached, at which point sampling becomes linear. This allows maximum resolution on rapidly changing early data without wasting memory later in the test.

You won't be able to use the keypad for about a minute after a log test starts.

Event: Probes are sampled on a periodic basis, and only those measurements that meet specific criteria are stored. You describe the period between regular storages, the criteria used to develop the event storages, and the channel to which the criteria are applied. This allows the capture of aperiodic data at higher resolution.

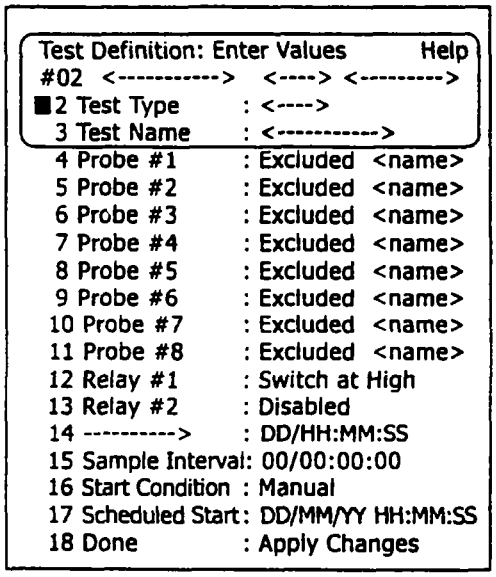


Figure 4-2. The complete Test Definition Menu for Linear and Log tests.

a. Move the cursor to a probe you want to include in the test and press ENTER.

b. Press the left or right arrow to toggle it from Excluded (the default) to Included, and press ENTER again.

c. Repeat these steps for each probe you want to include in the test.

Note: You will not be allowed to include undefined probes.

7. **Relays**: The HERMIT's two relays can be set to control external equipment (e.g., pumps, valves, alarms) based on the values the probes are measuring. Each relay can be disabled, or set to switch at a specified high or low value from a designated channel. For more detailed information on the relays, see page 28.

To change the current relay values requires an excursion into the Relay Definition Menu, as follows:

a. Select a relay you want to change. The Relay Definition Menu (see Figure 4-3) opens, with the cursor on the relay status line for the selected relay.

b. Press ENTER to edit the relay status. Choose from Disabled, Switch at High, and Switch at Low.

If you selected Disabled, go to step f; otherwise continue with the next step.

c. Enter the channel to be associated with this relay.

d. Enter the High Point, in the channel units. If the relay is set to "Switch at High," then a value higher than this will cause the relay to *open*. If the relay is set to "Switch at Low," then a value higher than this will cause the relay to *close*.

Remember that the CLEAR key can be used to back out of any display. If you end up in a menu or display that you hadn't intended to be in, just press CLEAR to back up.

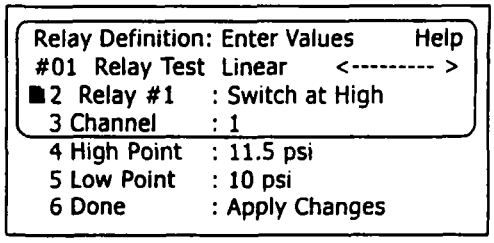


Figure 4-3. The Relay Definition Menu.

e. Enter the Low Point (channel units). If the relay is set to "Switch at Low," then a value less than this will cause the relay to *open*. If the relay is set to "Switch at High," then a value less than this will cause the relay to *close*.

f. Select **Done: Apply Changes**. The Test Definition menu returns to the screen.

8. **Sample Interval:** The time between measurements. Enter Days, Hours, Minutes, and/or Seconds, following the pattern in the line immediately above. Minimum: 10 seconds (longer for probes with long warmup times; refer to "Sample Interval" at the end of this section for specifics). Maximum: 7 days.

   In a Log test, the Sample Interval designates the ***longest*** time between measurements. When this interval is reached, the sampling schedule becomes linear. The standard log schedule is described in Section 5 of the *Win-Situ User's Guide*. Minimum: 10 seconds. Maximum: 8 hours.

9. **Start Condition:** Select Manual or Scheduled.

   A **Manual** test can be started from the keypad at any time.

   A **Scheduled** test starts at the date and time you specify. Enter the date and time for the scheduled start on the next line.

If you selected an Event test, continue with the steps below. If you are defining any other type of test, skip to step 13.

Defining an Event Test

In an Event test, each measurement on the "Event channel" is compared to a reference data point. The initial reference is taken at the start of the test. If a measurement varies from the reference by less than a "Delta" value you specify, the measurement is not stored. If a measurement varies from the reference by the Delta value or more, the measurement is stored. **The stored data point becomes the new reference for comparison.**

10. **Event Channel.** Though all Included channels are sampled, only one is scanned for Delta values. Press ENTER to select the Event Channel field, key in the number of the channel you want to designate as the Event channel, and press ENTER again.

11. **Default Store.** If your Delta value is not being met, then no "event" is occurring and no measurements will be stored. To avoid this, you can specify that data from all channels be stored every n samples, regardless of the Delta comparisons. For example, if the sample interval is 10 minutes, and you specify a default store of 6, measurements will be stored to the data file every hour, whether Delta is

being met or not. Minimum: 0 (no default measurements will be stored). Maximum: 99.

12. **Delta.** Enter the "difference" value that will trigger an event storage. Very small values should be avoided.

To store your entries in the Test Definition Menu, be sure to select the Done option.

To abandon the changes, press CLEAR.

Completing the Test Definition

To store this test definition in the HERMIT's memory:

13. Select the last option on the Test Definition menu, **Done: Apply Changes**. The HERMIT displays "Defining Test," then returns to the Test Action Menu.

    Note: If you defined a Manual start test, you can start it right away using option 3 **Start Manual Test**. See below.

Starting a Test

Use this option to start tests that are defined for a Manual start.

1. At the main Test Menu, select the Manual test you want to start.

2. At the Test Action menu, select action 3 **Start Manual Test**.

   If the test wasn't set up for a Manual start, an error message is displayed.

When a test starts—

- *If another test is running, the HERMIT stops it first, then starts the new test.*
- *You can't Define tests (or Cancel, Delete, Pack, Clear).*
- *If it's a log test, the keyboard is inactive for the first minute.*
- *It's OK to CLEAR out to the Start display, then press WAKE to turn the unit off and conserve battery power. The HERMIT will continue taking data.*

3. The HERMIT starts the test. The menu indicates that the test is "Running."

   Note: If another test is running, it will be stopped, and the selected test will be started. Depending on how busy the HERMIT is, this can happen virtually simultaneously.

Stopping a Test

There's no way to program the end of a test into the test definition. In most cases, the Stop function is the only way to stop a running test. Exceptions: A test stops automatically when

- another test starts
- the HERMIT's memory is full

Procedure

1. At the main Test Menu, select the "running" test you want to stop.

2. At the Test Action Menu, select action 4 **Stop Active Test**.

   The HERMIT stops the test. The menu indicates that the test is "Completed." The Main Test Menu now shows the number of samples (data points) collected.

To view the data from a just-stopped test, see Section 5. To transfer the test data to a computer, see Section 6.

If a test is running, you won't be able to Define a test, Cancel a test, Delete a test, Pack the memory, or Clear a test definition.

Cancelling a Test

If you change your mind or your plans, it's easy to cancel a Scheduled test before it starts.

1. At the main Test Menu, select a Scheduled test you want to cancel. It will say "Defined" and display a Start time but no End time. # Samples: 0.

2. At the Test Action Menu select action 5 **Cancel Scheduled Test.**

   The HERMIT 3000 cancels the test. If you CLEAR to the Main Test Menu you'll see that the start time has been replaced with zeroes but the test is still "Defined." It's now a "Manual" test that can be started at any time.

Other Test Operations

Viewing Test Results, Marking Test for Deletion, Packing the Test Memory, and Clearing the Test Definition are described in Section 5, Data.

Hermit 3000 Relays

The HERMIT 3000's external relay connector is wired to two relay "switches." There are three signals for each relay:

- Normally Open
- Common
- Normally Closed

These relay switches can control equipment external to the HERMIT such as pumps or valves.

When enabled, the relays open and close according to the values measured by a probe (channel) associated with the relays by the user. When the measured value exceeds a level set by the user, the switch opens. When the measured value returns to the level set by the user, the switch closes.

Because the HERMIT 3000 controls sampling frequencies through log, linear, and event "tests," there is a separate relay setup for each test. Since tests may be initiated manually or scheduled to execute at a given time, the user can selectively activate the relays as the situation requires.

The relay setup requires four user-entered values:

- The relay is disabled, enabled to switch at the high point, or enabled to switch at the low point
- The probe number (channel) associated with the relay
- The high point value in given units
- The low point value in given units

The high and low points determine at what measured value the relays will open and close. Two levels provide hysteresis to avoid fluttering when the measured value is near the switch point.

At both the start and end of a test the relay is set to the "normal" position. That is, the normally-closed contact is closed, and the normally-open contact is open. While a test is executing, the relays open and close depending on the values measured on the probe (channel) selected by the user.

Switch at High. When the user defines the relay setup as "switch at high point," a measured value on the associated channel that is numerically greater than the high point causes the relay to open (i.e., the normally-closed contact becomes open and the normally-open contact becomes closed). The relay will not return to the closed state (i.e., the normally-closed contact is again closed and the normally-open contact is again open) until a value is measured on the associated channel that is numerically less than the user-entered low point.

Switch at Low. Conversely, when the user defines the relay setup as "switch at low point," a measured value on the associated channel that is numerically less than the low point causes the relay to open (i.e., the normally-closed contact becomes open and the normally-open contact becomes closed). The relay will not return to the closed state (i.e., the normally-closed contact is again closed and the normally-open contact is again open) until a value is measured on the associated channel that is numerically greater than the user-entered high point.

The user-entered high/low points are expressed in the units selected by the user when defining the characteristics of the probe. Remember that setting high and low points too close together can cause the relay to flutter due to the natural noise in the measured values. Also remember that the relays are set to the "normal" position both at the start and end of a test.

Sample Interval

The 10-second minimum Sample Interval is determined by the HERMIT's ability to communicate via its keypad and LCD display while a test is running.

The Sample Interval must be greater than the sum of the warmup times on all active channels. Specifically, if the sum of the warmups is less than 900 milliseconds (mS), the minimum Sample Interval is 10 seconds. If the sum of the warmups is 900 mS or more, then the minimum Sample Interval is 9.1 seconds, *plus* the sum of the warmups, rounded up to the next second.

"Stepping" a Test

This procedure is useful when running constant rate and stepped rate pump tests with or without a recovery phase, or anytime you want to restart the log cycle. If you're familiar with the "step" function in earlier HERMIT models, here's how to duplicate it with the HERMIT 3000. The main difference is the requirement to define in advance all the tests ("steps") you will need.

To run a series of "steps":

First, define as many Manual Start tests as you will need. You can have up to 10.

Then, start each test in the usual way—(a) in the main Test Menu, select the test you want to start, (b) in the Test Action menu select 3, ***Start Manual Test.***

> *If a test is running, the HERMIT 3000 will stop the active test and* immediately *start the selected test. Depending on how fast the logger is taking data, this can happen virtually simultaneously.*

Step Test Hot Key: *If time is of the essence, here's a faster way to start each test in a series of pre-defined Manual tests. The – (minus) key in the lower right corner of the keypad provides instant access to the first test that can be started (i.e., a Defined but not Scheduled or Completed Manual Start test). Here's how it works:*

1. *If the HERMIT has dozed off, wake it up first.*
2. *Press the – (minus) key.*
3. *Press ENTER to start the first available Manual Start test. The HERMIT starts the test, and displays the main Test Menu. If it's a log test, you won't be able to use the keypad for about a minute.*
4. *Repeat steps 2 and 3 until there are no more tests that can be started.*

- *If you change your mind, just press CLEAR after pressing –; this returns you to where you were when you pressed the hot key.*
- *The hot key works from anyplace in the HERMIT menu structure except a numeric field.*

5 Data

To transfer test data to a personal or portable computer, see Section 6.

Test results are stored in the HERMIT 3000 until you delete them.

In most cases, you will probably want to transfer the test to a computer before deleting it from the HERMIT. This function cannot be performed in the HERMIT's internal software. Win-Situ is required.

The internal software provides a convenient way to take a quick look at the test data. When the HERMIT is connected to a PC running Win-Situ, a wider range of display, manipulation, and graphing capabilities is available.

You can view data for a linear or event test as soon as the test starts. For a log test, you'll have to wait about a minute.

Viewing Test Results

1. At the main Test Menu, select the test you want to look at. Note that the screen displays the start and end time of each test, as well as the number of samples.

   Hint: Key in the test number and press ENTER to go right to that test without scrolling through them all.

2. At the Test Action Menu, select action 6 **View Test Results**.

3. At the View Test Menu, select option 2 **View Test Data**.

   The HERMIT displays as much of the test as possible. See Figure 5-1 at the top of the next page.

The display starts at the beginning of the test with the lowest-numbered channel. There are several ways to move around and view more of the test data:

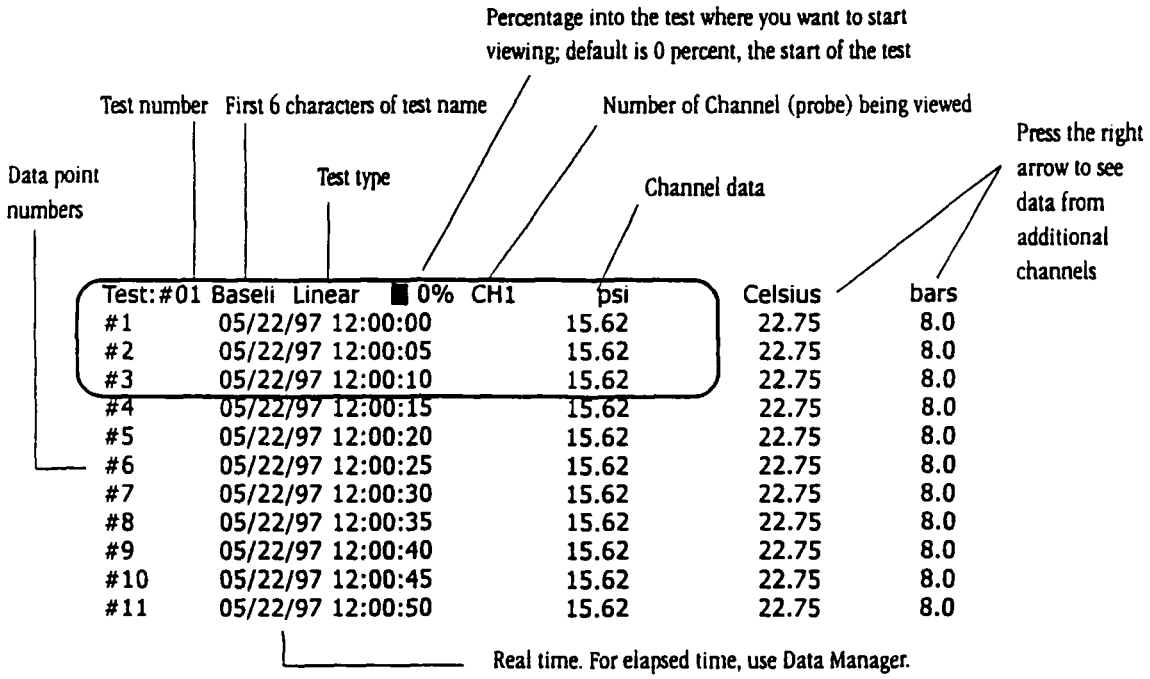


Figure 5-1. The HERMIT can display test data 3 lines and 1 channel at a time. The outline indicates the area of the LCD.

- Note that the cursor is sitting next to 0%. This is the percentage into the test to start viewing. 0% is the start of the test. To jump to another point in the test, key in a percentage. For example, to go to the middle of the test, key in 50. To go to the end of the test, enter 99.
- The up and down arrow keys scroll through the numbered data points, 3 lines at a time. Note that the percentage into the test changes with each press of the up or down arrow.
- Press the right arrow key to display the data from the next channel. Each press displays an additional channel, one at a time, until all channels have been shown and channel 1 appears again.

Barometric pressure is always displayed on the "last" channel, that is, one right-arrow-press beyond the highest-numbered channel in the test.

To exit the data display, press CLEAR.

Redefining the Data View

While viewing data, you can change the units for any channel, then return to the

data view. Only the display of data is affected, not the data file.

1. At the data display, press CLEAR to back out to the View Test Menu.
2. At the View Test Menu choose option **3 Redefine View**.
3. Select **Redefine Units**.
4. Change the units like this:
   a. Select a unit you want to change.
   b. Press the left/right arrows to display the available units.
   c. Press ENTER when the desired unit is displayed.

   Repeat for each unit you want to change.
5. Select **Done: Apply Changes**.

   To view the data with the new units, select **2 View Test Data** at the View Data Menu.

The Delete and Pack operations cannot be carried out while a test is running

Deleting Tests

Tests remain in the HERMIT 3000's memory until you delete them. To protect your valuable data, deleting is a deliberate, two-step process. First, you "mark" one or more tests for deletion using the **Delete Test** option. Then you remove all "marked" tests in a single step with the **Pack** operation.

Procedure:

1. At the main Test Menu, select a test you're ready to delete.
2. At the Test Action Menu, select action 7 **Delete Test.**
3. If no test is running, the HERMIT "marks" the test for deletion.
   - If a test is running, the HERMIT flashes an error message. You can't delete a test while another test is active.
   - The test menus now display "DEL" to indicate the test is ready to be permanently deleted the next time you run the Pack operation, as described below.

Packing the Memory

This operation removes from the HERMIT all tests that have been "marked" for deletion, and reorganizes the storage. This is called "defragmenting, or packing, the flash memory." The operation can be done many thousands of times, but eventually it may wear out the logger's memory. For this reason, it should be used only when it is needed—that is, only when the HERMIT 3000 is too full of data to run the tests you want to run. You can use Win-Situ's Information command to check the available memory.

Be sure you've extracted any tests you want to save before packing the memory. Once the memory is packed the deleted test cannot be recovered!

Procedure:

1. At the main Test Menu, select any test.
2. At the Test Action Menu, select action 8 **Pack All Test Memory**. In order to display this menu, of course, you need to select a single, specific test. However, the Pack operation removes ALL tests that have been marked for deletion.
3. If no test is running, the HERMIT begins the Pack operation. The following will happen:
   - Data from all deleted tests in the HERMIT—all those with "DEL" on the Test Menu display—will be permanently removed from the logger.
   - The logger's memory will be reorganized to optimize future data storage. Depending on how full the memory is, the process can take a minute or more.
   - The test definitions for deleted tests will be rewritten as Manual start tests, so that you can run them again.

Tests that haven't been marked for deletion won't be affected by the Pack operation. They will remain safely in the HERMIT's memory.

Clearing a Test Definition

You can delete a test definition for any test that has no data—i.e., after the logger memory has been packed, after a Scheduled test has been canceled, or before a Manual test runs.

Procedure:

1. In the main Test Menu, select a test with no data (# Samples: 0).
2. In the Test Action Menu, select action 9 **Clear Test Definition**.
3. The test definition will be deleted.

It doesn't hurt to keep a test definition "on file," so long as you don't need the blank number for another test. In fact, keeping a few definitions for repeated use can save time when defining tests.

Data Protection

Several built-in safeguards prevent you from accidentally deleting, erasing, or writing over your test data.

- You are not allowed to redefine a test that has data in it.
- Win-Situ's extract/save operation copies a test data file to your computer, but doesn't delete the test data from the HERMIT.
- Deleting test data is a deliberate, two-step process: Delete, then Pack. Deleted tests can be viewed and extracted. In Win-Situ, they can even be "undeleted."

6 Win-Situ

To download data from the HERMIT, a computer running Win-Situ (or a palmtop running DOS-Situ) is required. For other operations, Win-Situ is optional.

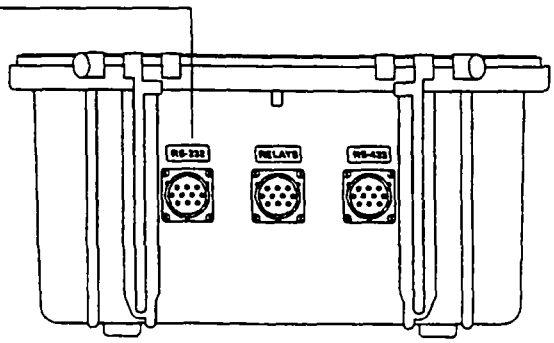
When a personal or portable computer (PC) is available, you may find it more convenient to set up probes and tests using Win-Situ, In-Situ's Data Acquisition software for Windows.

Win-Situ requires (at a minimum) a computer with a 386SX processor, running Microsoft Windows 3.1 or later in Enhanced mode, and equipped with a serial communications port, 4 megabytes of RAM, a hard disk, VGA compatible 640 x 480 display, and a Windows-compatible mouse or other pointing device.

Hardware Connections

1. Connect the HERMIT 3000 to the computer's serial port using the communication/power cable accessory and the HERMIT's RS232 serial port.
2. If an external power source with an AC adapter is handy, you can conserve battery power by plugging it into the power jack on the short arm of the communication/power cable.

RS-232: *To computer*



Use the port labeled "RS-232" and the RS232 comm cable to connect the HERMIT 3000 to a PC. The other ports are for other purposes and are described in the Appendix.

Using Win-Situ

Complete instructions may be found in the *Win-Situ User's Guide*. The steps below are a quick overview.

1. Install Win-Situ on the PC, and start Win-Situ.
2. Select and configure the COM port, if Win-Situ asks for this information.
3. From Win-Situ's Network Menu, select **Synchronize Baud**.

   After communication is established, an icon of the HERMIT 3000 appears below the COM port in the entity list.
4. To communicate with the HERMIT, click its icon, then select a button from the toolbar or an option on the Device Menu.

Extract = copy, transfer, download, upload.

Extracting Data

Use the ***Extract*** button in the Test Facility to copy test data from a HERMIT to a PC. Complete instructions are in the *Win-Situ User's Guide*, Section 5, "Extracting, Viewing, & Saving Data." Here's a quick summary:

1. Open the HERMIT"s Test Facility. Double-clicking the HERMIT icon is a quick way to do this.
2. Select a test you want to extract.
3. Click the ***Extract*** button.
4. After the download, click ***Save***, and supply a name for the binary (.bin) file.

Be sure to put the HERMIT to sleep before trying to talk to it through Win-Situ (CLEAR out to the Start display, then press WAKE).

Using Data Manager

Data Manager is Win-Situ's companion program for managing test data files after extraction from the HERMIT 3000 to the computer.

Data Manager —

- is installed when you install Win-Situ.
- is activated automatically when you extract a test in the Test Facility.
- is available on Win-Situ's Tools Menu, and on the toolbar.
- can display, graph, manipulate, and print test data files.
- can be started as a separate application for use with data files that have been extracted from the logger and saved to the computer.

Complete details on using Data Manager are in Section 6 of the *Win-Situ User's Guide*. Here's a quick procedure to try.

1. Start Data Manager.
2. Click **Open** on the File Menu.
3. Select a test file (.bin file) previously extracted and saved. Click ***OK***.
4. When the file opens, click the graph button on the toolbar to view the test data in graph form.

7 Utilities & Help

Help Menu

To display the Help Menu:

1. At the START display, press the up arrow until the cursor is on the H in Help at the top right corner of the screen.
2. Press ENTER.

Select topics from the Help Menu the same way you select items from the other HERMIT 3000 menus:

- The up and down arrows move the cursor through the list of help topics.
- ENTER selects a specific topic.
- The up and down arrows scroll through the topic.
- CLEAR returns you to the Help Menu. Press it twice to return to START.

Topical Help

Context-related help is available from most menus. When you need specific help, try this:

1. Press the up arrow until the H in help (always at the top right corner of the screen) is highlighted, then press ENTER.
2. Use the up/down arrow keys to scroll the help topic.
3. Press CLEAR to return to where you were.

Setting the Timeout

If you haven't pressed a key for about 2 minutes, the HERMIT will blank its display and doze off. The length of this "sleep delay" is controlled by the **Timeout** option on the Utility Menu.

Procedure:

1. At the START display, select the Utility Menu.
2. At the Utility Menu, select **Timeout**.
3. Key in a new value. Max.: 999 minutes.
4. Press ENTER.
5. Select Done to return to START.

The new Timeout remains in effect until the HERMIT times out once at the new value, or is turned off. After either of these events, the Timeout resets itself back to 2 minutes.

Reloading Firmware

From time to time, In-Situ may make available upgrades to the HERMIT's firmware. New firmware can be loaded into the HERMIT 3000 from a diskette or a file on your hard disk.

Instructions for loading new firmware may be found in documentation supplied with the firmware.

Resetting the CPU Runtime Counter

The CPU Runtime counter tabulates the number of seoonds the HERMIT has been "awake" since the last battery replacement. The reset feature allows the counter to reset to zero when the battery is replaced. Although you can reset it anytime, bear in mind that the counter will convey more information on battery status if it reflects the actual number of seconds since the last battery replacement.

Procedure:

1. First, use the Logger Menu to check the clock. Reset it if necessary. (See page 11.)
2. Display the Utility Menu.
3. With the cursor on option 3, **Reset CPU Runtime**, press ENTER.

   The CPU Runtime is reset to zero and the Battery Replacement Date to today's date. You can check both of these items in View Device Information on the Logger Menu.

8 Warranty & Service Information

Warranty Provisions

In-Situ Inc. warrants all products sold, excluding batteries sold with such products, against defects in materials and workmanship under normal operating conditions. Such products include data loggers, probes, and accessories, and are warranted for the following periods: TROLL and MP TROLL data loggers for five years; HERMIT 3000 data loggers for two years; probes for one year; and all other products, including accessories and cable, for ninety days. The warranty period for all products begins on the day the product is first delivered to the customer.

During the warranty period, In-Situ will repair, or, at its option, replace at no charge, components that have proven to be defective during the period of warranty, provided that the warranted product is shipped, prepaid, to In-Situ Inc. In-Situ's Customer Service staff must be contacted for shipping instructions prior to shipment.

These warranties do not apply if the warranted product has been damaged by common negligence, accident or misuse. These warranties do not apply to any product that has been repaired, serviced, or modified by an unauthorized person.

THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH EXTEND BEYOND THE FACE HEREOF. NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE ARE MADE BY IN-SITU INC.

In-Situ Inc.'s obligation and liability under this warranty is expressly limited to repairing and replacing, at In-Situ Inc.'s option, any product found to be defective or otherwise not in conformity with this warranty. The obligation to repair or replace shall terminate when the warranty expires.

In-Situ Inc.'s maximum liability in damages to customer, from whatever source, including any breach of contract, shall be limited to the difference between the delivery price of the product and the market price of the such product at Customer's destination at the time of such breach. IN NO EVENT SHALL IN-SITU INC. BE LIABLE FOR PERSONAL INJURY, PROPERTY DAMAGE, LOSS OF PROFIT, DELAY OR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHETHER ARISING FROM CONTRACT, BREACH OF CONTRACT, TORT, IN-SITU INC.'S NEGLIGENCE, STRICT

LIABILITY OR THE BREACH OF ANY EXPRESS OR IMPLIED WARRANTY, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

To Obtain Repair Service

If you suspect that the HERMIT 3000 is malfunctioning and repair is required, you can help assure efficient servicing by following these guidelines:

1. Call In-Situ Customer Service toll-free at 1-800-446-7488.

Please . . . call us before you return equipment, and remember to put the RMA number on the label.

2. Be prepared to describe in detail the exact nature (symptoms) of the malfunction, including the test type, probes in use, and the conditions noted at the time the malfunction occurred.

3. If service is required, obtain an RMA (Return Material Authorization) number from service personnel.

4. Write a description of the symptoms for service personnel, indicating whether the malfunction occurs intermittently or constantly. Save printouts or other materials that illustrate the problem.

5. Pack the HERMIT 3000 in its original shipping box if possible. Include your write-up of the symptoms and any other supporting documentation.

6. Send the package, shipping prepaid, to:

   In-Situ, Inc.
   Customer Service
   ATTN: RMA # (assigned no. here)
   210 South 3rd Street
   Laramie, WY 82070

The warranty does not cover damage during transit. In-Situ recommends the customer insure all shipments. Warranty repairs will be shipped back prepaid.

Serial Number

Each HERMIT 3000 carries an individual serial number engraved on the bottom of the case. It is recommended that owners keep a separate record of this number. Should your HERMIT be lost or stolen, the serial number is often necessary for tracing and recovery, as well as any insurance claims. If necessary, In-Situ maintains complete records of original owner's names and serial numbers.

Appendix: Operation & Maintenance

Please save all packing materials for future storage and shipping of the instrument. In the case of equipment with lithium batteries, the shipping boxes have been performance tested and are the only containers approved by DOT for shipment of the equipment.

The information in this section covers the initial setup of your HERMIT 3000 and includes procedures for the proper use and care of the instrument.

Please read and become familiar with this information before attempting to operate your HERMIT 3000.

Unpacking and Inspection

Your HERMIT 3000 is another example of the quality and attention to detail in engineering and construction that have become a trademark of In-Situ instrumentation. Each instrument is thoroughly tested and calibrated by people who are dedicated to providing you with the best possible product and service.

Your HERMIT 3000 was carefully inspected before shipping and should be ready to operate right out of the box. Check the instrument for any physical damage sustained during shipment. Notify In-Situ and file a claim with the carriers involved if there is any such damage; do not attempt to operate the instrument.

Probes and other optional accessories may be shipped separately and should also be inspected for physical damage and the fulfillment of your order. If any accessory items are missing, please contact In-Situ immediately.

Probe Connectors

The HERMIT 3000 can handle as many as eight 4-20 mA probes. The probe connectors are numbered 1-4 on the left side of the unit, and 5-8 on the right side.

Proper operation of a probe is dependent upon a clean, dry connection. Make certain that connectors are clean and dry before installing them.

The connectors are designed so that mating cables fit only one way. If a connector jams during installation, it may be upside down or blocked by dirt or other foreign objects. Never try to force a connection.

Keep connectors capped when not in use

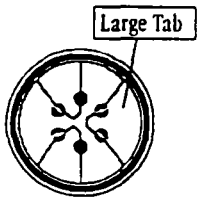
Although the connectors are water-resistant even without their protective caps, the pins are subject to damage by dirt and other foreign objects unless the connectors are properly attached to a mating cable or protective cap. Please observe the simple precautions at left.

Install connectors as follows:

1. Remove the protective cap from the connector. If the mating cable has a protective cap, remove it also.
2. Orient the connector patterns so that the large tab in the cable connector aligns with the V-shaped notch in the HERMIT connector.
3. Gently press the connector halves together. Excessive force should not be required.
4. Tighten the lock ring to establish a tight connection and water-resistant seal.

To remove a connector, reverse the procedure:

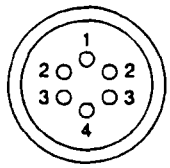
1. Loosen the connector's lock ring.
2. Gently pull the connector halves apart. Replace all protective caps.
3. Store the probe in its original container or where it will be safe from damage to the contacts.



Connecting Other 4-20 mA Devices

In-Situ transducers are polarity-sensitive (white=positive, black=negative). Refer to the diagram below.

A prewired kit is available from In-Situ Inc.



Connector Position	Conductor Signal
1	GND
2	4-20 mA
3	20 V DC

Comm Port Connectors

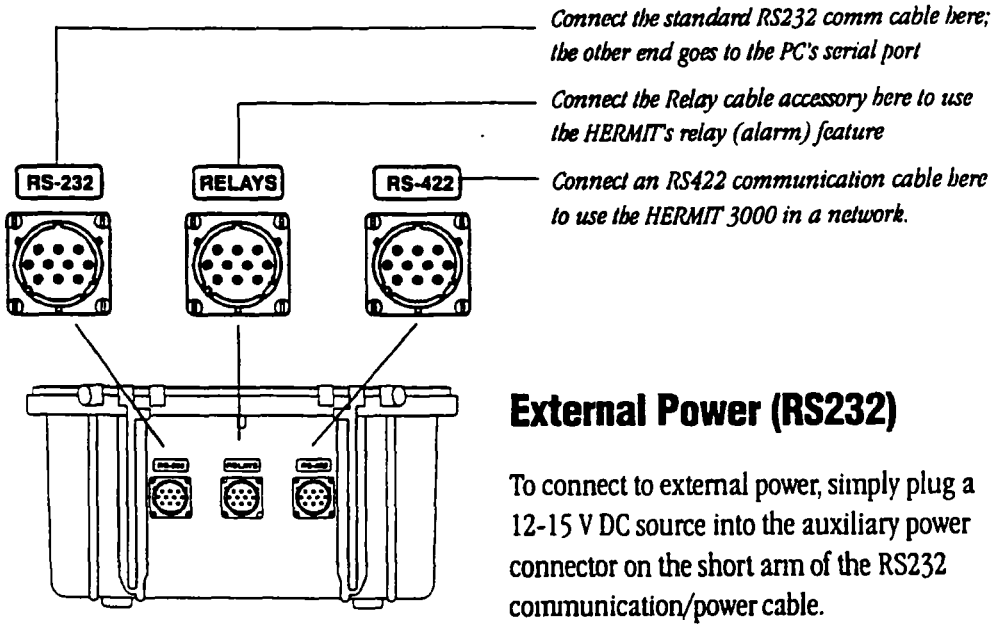
The HERMIT has two serial ports on the back labeled "RS-232" and "RS-422" (see illustration opposite). **RS232** is for connection to the standard serial port on a PC. **RS422** is for network connections.

Connecting to a PC

The RS232 communication/power cable (available as an accessory) is a short length of cable with a round connector for the HERMIT's RS232 serial port at one end, and two connectors at the other end: an external power jack, and a "DB" connector.

Procedure:

1. Remove the protective cap from the HERMIT's RS232 port. If the connector on the communication/power cable has a protective cap, remove it also.



To avoid damage to the HERMIT or the computer from electrostatic discharge (ESD), be sure to use proper ESD precautions.

2. Align the notches, press the connector halves together, and tighten the lock ring until it clicks into position.

3. Plug the DB connector into the computer's serial port. The cable supplied fits a standard 9-pin male port. For a 25-pin male port use a 9-to-25-pin adapter.

Relay Connector

A relay cable accessory provides control switching from the HERMIT 3000. Contact In-Situ Inc. for the Relay Accessory Kit.

External Power (RS232)

To connect to external power, simply plug a 12-15 V DC source into the auxiliary power connector on the short arm of the RS232 communication/power cable.

The HERMIT 3000's internal battery pack is designed to supply the instrument and probes with clean, reliable power for several years. You can extend the life of the battery by using external power whenever it is convenient. The HERMIT 3000 will automatically switch over to external power when it is present and back to its own internal battery pack if the external power source is disconnected or depleted.

Battery Information

Lithium Battery Pack

The HERMIT's internal lithium battery pack consists of 6 lithium D-cells. The lithium battery pack is ***not user-replaceable***. The

There are no user-serviceable parts in the HERMIT 3000. Do not attempt to service the unit yourself; doing so can cause permanent damage to the instrument and will void your warranty. Instrument design and circuitry are proprietary to In-Situ and service manuals are not available to customers.

HERMIT 3000 must be returned to the factory for lithium battery replacement. Contact In-Situ Customer Service at 1-800-446-7488 as described on page 40.

Alkaline Battery Pack

The alkaline battery pack consists of 8 heavy-duty alkaline D-cells. A replacement alkaline battery pack is available only from In-Situ Inc. Contact your In-Situ sales representative for a replacement battery pack and installation instructions.

Operating Considerations

The HERMIT 3000 has been designed to withstand the harsh conditions frequently encountered in field use. However, as with any electronic instrument, it can be permanently damaged if used outside its operating specifications.

Note that the temperature range is narrower with an alkaline battery. Also, the internal barometric sensor will not operate properly below to -20°C.

Temperature Range

Alkaline battery -10° to 45°C (14° to 113° F)
Lithium battery -40° to 70°C (-40° to 158° F)
Barometric sensor -20° to 70°C (-4° to 158° F)

Installation in hot and sunny climates may require the use of a shade. In very cold climates, it may be necessary to insulate the instrument.

The HERMIT 3000 is designed to be used around water, but reasonable caution should be used to prevent internal water damage. Do not submerge any part of the instrument or allow it to stand in water. Cap all connectors that are not in use. When the keypad is not in use, close and latch the lid and close the purge knob (turn clockwise).

Calibration

The HERMIT 3000 is designed to maintain its accuracy specifications through its useful service life without requiring periodic calibration. The accuracy of the instrument can be adversely affected, however, by:

- improper care and handling
- lightning strikes and similar surges
- exceeding operating temperature limits
- physical damage or abuse

Under these circumstances it may become necessary to recalibrate the instrument. Contact In-Situ Customer Service for information on periodic checks and recalibration.

General Cleaning

Before cleaning, disconnect the HERMIT 3000 from the PC and/or external power and make certain that unused connectors are properly capped. Clean with a soft cloth dampened in clean water or in water containing a mild detergent. Dry promptly with another soft cloth. Avoid abrasive cleaners. Do not steam clean.

Keep the barometric pressure openings (on the back and in one foot) free of blockage.

Specifications

General

Case material	Injected plastic
Dimensions	12" wide, 10" deep, 6.75" high (30.5 x 25.41 x 17.2 cm)
Weight	8.5 lb. (3.9 kg) alkaline, 8.2 lb. (3.7 kg) lithium
Operating/storage temperature	
with alkaline battery	-10° to 45°C (14° to 113°F)
with lithium battery	-40° to 70°C (-40° to 158°F)
barometric sensor	-20° to 70°C (-4° to 158° F)

Data Sampling

Number of channels	8 external plus 1 internal (barometric pressure sensor)
Memory type	Non-volatile
Capacity	944 Kilobytes (at least 475,000 data points)
Accuracy	±0.05% full scale
LCD	5.75" x 1.25" (14.6 x 3.2 cm), 4 lines of 40 characters each

Transducer Input

Type	Standard 4-20 mA probes, type is software-selectable
Source voltage	20 V DC, pulsed
Source current	80 mA max.
Source pulse width (probe warmup time)	50 milliseconds to 30 seconds, user adjustable

Input resistance	150 ohms typical
Maximum cable length	5000 ft. (with In-Situ pressure probe)
Relays	2 relays (2 amperes max.) 30 V DC or 30 V AC max.

Communications

Type	RS232 and RS422 (for networking)
Hardware compatibility	IBM 9-pin

Battery Options

Alkaline	Up to 500,000 (est.) data points or 2 years within the operating temperature range, assuming use of one probe, external power during setup and downloading
Lithium	Up to 1,500,000 (est.) data points or 5 years within the operating temperature range, assuming use of one probe, external power during setup and downloading
Lead-Acid	
Clock/memory battery	5-year factory-replaceable long-life backup battery

External Power Input

Input voltage	15 V (RS232), 48 V (RS422)
Input current	200 to 500 mA (with backlight)

Due to continuing product development this information is subject to change without notice.

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